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ABSTRACT

The education of scientists and engineers in China was severely interrupted and for all practical purposes discontinued during the years of the Cultural Revolution (1966-1972). This study covers the evolution of the educational system in China since that time. The study updates the Committee on Science and Technology's 1980 study of science and engineering manpower in China. Such an updating has become desirable due to the growing availability of statistical information about China's educational program for scientists/engineers, and the numerous new ways in which China very recently has begun to utilize its science and engineering manpower resources. Major areas examined include: (1) the intellectual setting (considering plight of the scientist-intellectual, improvement of living conditions, and policy formation); (2) restoring higher education (including a statistical perspective and discussion of enrollment issues and selection problems, curriculum, faculty, graduate education, and foreign training); (3) professional manpower (examining quantity and quality of graduate students and evidence/speculation about the number of scientific and technical personnel); and (4) problems of planning and utilization of scientific and technical manpower (focusing on enrollment versus requirements and improving distribution and utilization of scientists/engineers). A list of China's key colleges/universities and tables of selected statistics are included in two appendices. (JN)

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[COMMITTEE PRINT]

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THE TRAINING AND UTILIZATION OF SCIENTIFIC AND ENGINEERING MANPOWER IN THE PEOPLE'S REPUBLIC OF CHINA

SCIENCE AND TECHNOLOGY IN THE PEOPLE'S REPUBLIC OF CHINA
BACKGROUND STUDY NO. 5

PREPARED BY THE

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FOR THE

SUBCOMMITTEE ON
SCIENCE, RESEARCH AND TECHNOLOGY

TRANSMITTED TO THE

COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES
NINETY-EIGHTH CONGRESS

FIRST SESSION

Serial P

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LETTER OF TRANSMITTAL

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
WASHINGTON, D.C., *October 11, 1983.*

Hon. DON FUQUA,
Chairman, Committee on Science and Technology,
U.S. House of Representatives.

DEAR MR. CHAIRMAN: I am transmitting herewith a new study on "The Training and Utilization of Scientific and Engineering Manpower in the People's Republic of China".

The training of Chinese scientists and engineers is of both short term and longer term interest to the United States and the Congress. In the short term we are aware that significant number of Chinese young people currently are studying in American universities. Together with their counterparts now attending colleges and universities in Western Europe and Japan, they will return to form a Western-trained cadre of professionals and teachers in their country. In the longer term, we must recognize that the ongoing revival of engineering and science in China undoubtedly will yield, after year 2000, a strong producer of scientific research and development and a potential competitor on the world market.

The education of scientists and engineers in China was severely interrupted and for all practical purposes discontinued during the years of the Cultural Revolution (1966–1972). This study covers the evolution of the educational system in China since that time. It is particularly valuable because it places China's science and technology policies.

The study updates the Committee's 1980 study of science an engineering manpower in China. Such an updating has become particularly desirable in view of several developments: The growing availability of statistical information about China's educational program for engineers and scientists, and, perhaps more significantly, the numerous new ways in which China very recently has begun to utilize its science and engineering manpower resources.

The study is the fifth in our Subcommittee's series of Background Studies on Science and Technology in the People's Republic of China. The series was initiated in 1976 with the aim of maintaining the Committee's awareness of the developments in science and technology in the world's most populous nation. The steadily broadening bilateral cooperation between our two countries in sciences and technology will, I believe, make the series and this most recent study of particular interest.

As was the case with the Committee's earlier study in this field, this report is also done by Mr. Leo Orleans, who is a consultant to the Congressional Research Service of the Library of Congress. He is a well

known expert and scholar who has published extensively on Chinese science and population questions. We are indebted to him for providing us with a thorough, well-written, and authoritative work.

I commend this study to your attention and to the attention of the Members of Committee on Science and Technology and of the House of Representatives.

Sincerely,

DOUG WALGREN,
Chairman, Subcommittee on Science,
Research and Technology.

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PUBLICATIONS IN THE SERIES SCIENCE AND TECHNOLOGY IN THE PEOPLE'S REPUBLIC OF CHINA

BACKGROUND STUDY NO. 1

Annoted Bibliography on Science and Technology in China, 94th Congress, Serial TT, September 1976.

BACKGROUND STUDY NO. 2

Science in China and United States-China Scientific Exchanges: Assessments and Prospects, 94th Congress, Serial DDD, November 1976.

BACKGROUND STUDY NO. 3

The Role of Science and Technology in China's Population/Food Balance, 95th Congress, Serial H, September 1977.

BACKGROUND STUDY NO. 4

Manpower for Science and Engineering in China, 96th Congress, Serial YY, May 1980.

BACKGROUND STUDY NO. 5

The Training and Utilization of Scientific and Engineering Manpower in the People's Republic of China, Serial P, October 1983.

INTRODUCTION*

The People's Republic of China often seems to be ruled by slogans which symbolically identify political, social, or economic goals and inspire the population to pursue these objectives with enthusiasm. The "four modernizations" slogan has been serving just such a purpose. The fact that the specific contents and plans under the "four modernizations" have undergone significant modifications and that in the process the term itself has lost some of its original luster does not change its basic message: if China is to improve the living standards of her population and assume an international role commensurate with her size, then agriculture, industry, national defense, and science and technology will have to be modernized. It hardly needs noting, however, that the modernization of science and technology falls into a somewhat different category from the others, for this "most important link in the readjustment of the national economy" is basically a tool with which to modernize the other sectors. But to design a tool it is necessary to know exactly what its function will be; likewise, to make science serve the state objectives, it is necessary to translate slogans into a science policy.

Under the best of circumstances, the problem of relating scientific objectives and priorities to non-scientific societal goals is a difficult one. This, as Harvey Brooks pointed out, is "because the goals themselves are insufficiently formulated for easy translation into technical objectives, and because relating technical and social goals is actually an ill-developed art that has hitherto been based largely on conventional wisdom and political cliches." [1]

Another difficulty in integrating societal and scientific goals is the tendency for scientists to subscribe to the "trickle down" philosophy of science, which often puts them at odds with the national leadership. Such an approach may be valid for technologicially advanced nations. For example, research and development conducted in connection with the space program eventually resulted in significant advances in the daily life of the American public. But in less developed nations, where the gap between the standard of living of the population and the goals of basic research is so vast, "expensive science" is usually unproductive and unreasonable.

China pondered these basic problems for several decades. The leadership and the scientists fought constantly for control of the scientific establishment. The struggle, accentuated during periods of active radicalism, never really ceased. At the same time, "conventional wisdom and political cliches" were applied to ever-changing goals and policies, thereby negating any possibility of creating a reasonable and stable science policy.

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*My sincere thanks to Kyna Rubin, Amy Wilson and Jürgen Henze, who took my request for comments seriously, and to Dorothy Clark for her usual expert and unobtrusive editing.

[1] Harvey Books, "Science Indicators and Science Priorities," *Science, Technology and Human Values*, Vol. 7, No. 38, Winter 1982.

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Now, the direction of China's economic development seems reasonably clear and, at least in general terms, an effort is being made to spell out what is expected of the scientific and technological community. Just as the overly ambitious economic plans of the late 1970s had to be adjusted to match the country's capabilities, science too was forced to backtrack from some of the expensive, high-visibility, long-term projects. Now the leadership believes that China should be able to quadruple the gross annual value of industrial and agricultural production by the year 2000. This too may be only a slogan expressed as a goal, but in any case science and technology will have to lead the way by being more responsive to national economic objectives and by focusing most of the efforts on "problems of application and development." Of course, the difficulty of "creating a science policy" that will adequately support the nation's economic and social goals has not been eased, but the basic decision that the achievements of science and technology must be assessed in terms of the contribution they make to China's economic growth, is a principle which is likely to appear in any basic textbook on development strategy.

What then is needed to create a viable and effective scientific establishment? In a recent speech made to the science awards conference, Fang Yi listed three prerequisites to development of Chinese S&T: "able people, funds, and strengthened organization, management and service work." This paper is limited to "able people"—the most essential of the prerequisites and, since it is not susceptible to rapid repair, the most difficult to meet.

THE INTELLECTUAL SETTING

The quantity and quality of China's scientific and technical personnel cannot be discussed in a vacuum and it is important to understand the environment within which they are expected to perform. For several years now, China has been conducting an intensive campaign to improve this environment by upgrading the prestige and living conditions of intellectuals—a loosely used generic term. Based on the primary focus of the campaign, however, the term "intellectuals" should more appropriately read "scientists and engineers."

The Plight of the Scientist-Intellectual

The schizophrenia of the Chinese Communist Party with regard to intellectuals has dominated the course of developments in the People's Republic of China since the Party's creation, and has been thoroughly documented. "It was always the intellectuals who suffered the first blow" when leftist policies predominated, writes one Chinese scholar, and "their misfortune portended the approach of a disaster for the whole nation." [2] The author also chastises the West, saying that only "in class society different classes have different conceptions of the value of knowledge." Then he inadvertently admits that China continues to be a class society because severe political fluctuations have a direct effect on "the value of knowledge" as seen by the various factions within the leadership.

Although writers are usually the first to feel the wrath of every anti-intellectual campaign, there are several reasons why the high-level scientific and technical personnel were not excluded from attack. First, scientists and engineers in China had some of the most impressive credentials among the intellectuals. Second, many of them received their advanced degrees from foreign universities and were therefore exposed to (if not misguided by) bourgeois thinking. And, third, the advent of the more radical factions also tended to alter the basic approach to national development, to reorder the country's priorities, and to change the role that scientists and engineers would be expected to play. In their case, the derision heaped on all intellectuals could reflect much more directly on activities and professional status.

The Cultural Revolution, which started in 1966, was, of course, the most prolonged and devastating period for Chinese science and technology. It subjected "to ruthless persecution a large number of diligent and accomplished scientists with outstanding contributions, brought the whole scientific research to a near-total standstill, and resulted in the loss of a generation of scientific talents." [3] With the fall of the "gang of four" and the proclamation that science and

[2] Hu Ping, "On the Question of Intellectuals," *Beijing Review* (BR), No. 7, Feb. 16, 1981.
[3] Policy Research Office of the Chinese Academy of Sciences, "Chinese Academy of Sciences in 1980," unpublished paper.

technology would lead the country into modernization, Beijing quite naturally focused its attention on the re-building of the scientific and technical establishment, on drawing up new plans, on budgetary problems, on expanding and improving university education, and on other basic priorities. There was also some early concern about the status of intellectuals. At the March 1978 National Science Conference, Deng Xiaoping devoted more than half of his speech to explaining how "brain workers trained by the proletariat itself differ from intellectuals in any exploiting society" and urging the country to fully utilize them, "as long as they are not against the Party and against socialism."[4] Soon, however, the leadership recognized lip service alone would not change the set mind of the Chinese people. Ten years of propaganda had done its job. The repeatedly stated notion that people who worked with their heads instead of their hands were not involved in productive labor, had reinforced the traditional suspicion toward intellectuals. Prejudices die hard and a major campaign to change the severely damaged image of scientists and engineers was necessary. Thus, in December 1978 the Party Central Committee issued a directive which initiated a nationwide campaign to upgrade this image and improve the living and working conditions of intellectuals.

Progress was slow, however, and the presistence of the "more knowledge, more reactionary" attitude was recently summarized as follows:[5]

> Even now the pernicious influence of "Left" ideas still exists as to how to regard intellectuals. Their working conditions are far from satisfactory. Public opinions which reject and suppress intellectuals are not criticized in a systematic way from a theoretical point of view, but are still accepted by certain people. . . . Some indiscriminately demand that intellectuals be at the same time manual workers and peasants, as if mental workers are not workers; any intellectual who studies hard to further professional knowledge and use it in the service of the people is considered a "spiritual aristocrat." Such people would not tolerate intellectuals airing diverse views because, in their eyes, independent thinking means "opposing the leadership" or "arrogance," while to be submissive is virtuous.

In January 1982, the CCPCC issued a notice which required the Party to do a "a one-time check of its work toward intellectuals" and in May and June the "departments concerned" dispatched personnel to various localities to see how the work of improving the life of intellectuals was progressing. The returns from these surveys were discouraging and two aspects of the complaints stand out.

The first is the friction between the unskilled and the educated, which is in no sense unique to China. The example from Shaanxi is quite characteristic. It complains that many people still consider intellectuals as non-productive, "creating estrangement between the workers and peasants on the one hand and the scientific and technical personnel on the other, dampening the enthusiasm of the scientific and technical personnel."[6] This type of conflict is unfortunate, very

[4] *Peking Review*, No. 12, March 24, 1978.
[5] Hu Ping, op. cit.
[6] *Shaanxi Ribao (Shaanxi Daily)*, July 7, 1982; Joint Publications Research Service (JPRS), No. 81,777, Sept. 15, 1982.

difficult to eliminate, but need not be terribly destructive in terms of productivity.

Much more serious are the biases of the cadres against the intellectuals. Many of these managers and administrators completed only middle school, at best, and achieved their position in years when promotions came more likely as a result of "redness" than of "expertness." Especially in production settings, cadres tend to be jealous of the much younger college-educated scientists and engineers who are now telling them how to do their job and who may soon be replacing them. "Leading cadres at all levels should make friends with intellectuals," they are told, but in too many instances the admonition is in vain. Many managers apparently persist in accusing scientific and technical personnel of "not doing honest work." It is also said that managers are unaccustomed to the work style of intellectuals and show little understanding for non-job-related professional activities. One such report tells of an engineer specializing in optical instruments, whose manager denied him permission to write an article for an encyclopedia, to participate in conferences, or to consult with other units who requested his help, and harassed him in other ways.[7] Other complaints regarding scientific and technical personnel in factory settings include "not using and not transferring" them.[8]

There are innumerable examples in the press of the adversary relationship between the managers and the scientific and technical personnel. There is every reason to believe, however, that this very serious problem is gradually abating. The program to substitute professionals for politically appointed managers is well under way in the institutes and units affiliated with the academies. This process will take somewhat longer in production units, but in time most managers of urban plants and factories should also be "intellectuals."

Improving Living Conditions

Only a few plans pursued by the "gang of four" elicited popular support by the masses of the Chinese people. Among these, unfortunately, were policies that strengthened the existing prejudices against the intellectuals. But while it is relatively easy to play on the universal resentment of the "have nots" against the "haves," it is extremely difficult to reverse these attitudes. The new leadership, however, clearly understands that in addition to eliminating the psychological harassment of the intellectuals, the only way to get maximum returns from the country's limited scientific and engineering manpower is to substantially improve their living and working conditions.

In 1982 many provinces published recommendations for achieving these needed improvements. Each had its own wrinkles ("based on local conditions"), but they all covered basically the same points. The lists are most illustrative of the problems that require resolution and the one from Guangzhou is quite representative of the others.[9] Since some of the recommendations (paraphrased) appear to be a bit unrealistic, each is followed by a speculative comment on its feasibility.

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[7] *Wen Hui Bao, Shanghai*, June 19, 1981; JPRS, No. 81,722, Sept. 8, 1982.
[8] *Wen Hui Bao, Shanghai*, June 25, 1981; JPRS, No. 81,722 Sept. 8, 1982.
[9] *Nanfang Ribao* (Southern Daily), Aug. 20, 1982; JPRS No. 81,788, Sept. 16, 1982.

—Intellectuals must be cleared of all accusations made during the Cultural Revolution. For the overwhelming majority, this has been accomplished.

—Private homes that were seized must be returned. Given China's urban housing shortage this is most unlikely to take place, especially since each such action would undoubtedly displace several families having no place to go.

—Intellectuals should be paid retroactively for all deductions and suspensions in salaries during the Cultural Revolution. Some adjustments perhaps could be made on a very selective basis; it is very doubtful that payment would (or could) be made on an extensive scale.

—Intellectuals should spend five-sixths of their time on professional activities. If this ratio pertains to limiting participation in political study, as originally intended in the late 1970s, then this has been accomplished. However, professionals are said to spend an inordinate amount of time on shopping, washing, and a variety of other household chores which cut into the workday.

—To tap the potential of scientific manpower, such professionals must be supplied with "the necessary equipment, instruments, apparatuses, books, information and auxiliary staff." Most managers of research institutions and many managers of industrial departments undoubtedly recognize these needs; they are probably met to the extent the budget permits.

—Salaries must be readjusted and "special consideration given to the backbone forces of middle-aged intellectuals, especially those who have less than 30 yuan in living expenses per family member per month." This will be discussed in more detail below.

—Cars should be provided for older intellectuals at higher grades with 100 kg. of gasoline per month. Probably done on a highly selective basis for very special occasions.

—Efforts should be made to unite intellectual couples who live apart "so as to free their minds of apprehension." Probably done whenever possible.

—"Give preferential treatment to the employment problems of children of intellectuals." This would be a most unpopular policy which would only worsen relations between intellectuals and workers. While such preference may be shown, it is probably through "guangxi" (special ties based on kinship, native place, work or educational experience) rather than as policy implementation.

—And, finally, the article states that "We must warmly welcome and make appropriate arrangements for intellectuals who return home from abroad, especially those who have professional specialities." Such a statement would not be necessary if fitting these individuals into the workplace and providing them with preferential treatment as deemed appropriate were not problems.

As already mentioned, the above set of recommendations was drafted for the city of Guangzhou, but efforts to improve the living and working conditions of scientific and technical personnel were carried out throughout the country. The May-June 1982 national in-

vestigation of progress concluded that the problem of the older intellectuals (over 60 years of age) "has been mostly solved," but that the conditions of the middle-aged intellectuals (in their 40's and 50's) "are still poor." [10] The young intellectuals (those in their 20's and 30's), incidentally, are seldom mentioned. The explanation for this breakdown and the uneven concern of the authorities is not difficult to deduce. All of the puritanical mores have not yet disappeared from the society, and it is considered good for young intellectuals (and in China it is still difficult to be young and an intellectual) to struggle and suffer a bit before achieving a degree of comfort. And since the veneration of older people is still part of the Chinese culture, the workers and the cadres can accept the notion of providing the "older" intellectuals with creature comforts and respect. The middle-age intellectuals, however, are another matter. Not yet old enough to get consideration on the basis of age, they are the primary (if not the only) competitors of the present managers for positions of authority. Since the current national policy is to get as many professionally competent people as possible into management positions, a cadre could well be accelerating his own demise by promoting middle-aged intellectuals within the organiztion. No wonder that the prevalent opinion among many cadres who object to favoring intellectuals is characterized by statements that "they are going to cock their tails again," and that "the intellectuals are very difficult to deal with, because their desires are a bottomless pit which can never be fully satisfied." [11]

The middle-aged scientists and engineers are probably quite realistic about their own prospects for the near future. They are not the type to demonstrate for human rights or lead heroic struggles against the Party—an activity which is sometimes, rather wishfully, assumed of all intellectuals. Their main desire is that the "loving care and concern" pronouncements could quickly be translated into better housing, improved opportunities for advancement, and, most of all, increased salaries. Although in 1980 fifty percent of the scientific and technical personnel received pay raises,[12] salaries continue to be low. One source contrasts the average monthly wages of 60 to 70 yuan paid to scientists and engineers in their 40's and 50's, with the 30 to 40 yuan received monthly by college students in Shanghai for board and pocket money.[13] Even Deng Xiaoping, in his review of the nation's current situation and tasks, felt it was necessary to point out that there are many talented teachers and scientific workers "who earn a monthly salary of only tens of yuan," and that such individuals could solve many problems and create much more wealth for the state if their working and living conditions were improved.[14]

Other sources point out that because of low wages, intellectuals spend too much time shopping, cooking, washing, fixing bicycles, and doing other chores, rather than concentrating on reading and research, and that improvement of their living conditions "should be regarded

[10] *Guangming Ribao (Guangming Daily)* (GMRB), July 14, 1982; JPRS, No. 81,755, Sept. 13, 1982.
[11] *Zhejiang Ribao (Zhejiang Daily)*, Aug. 10, 1982; JPRS, No. 82,127, Nov. 1, 1982.
[12] Policy Research Office of the Chinese Academy of Sciences, "Chinese Academy of Sciences in 1980," unpublished paper.
[13] *GMRB*, July 14, 1982; JPRS, No. 81, 755, Sept. 13, 1982.
[14] *GMRB*, July 15, 1982; Foreign Broadcast Information Service (FBIS), July 27, 1982.

as a project of capital construction."[15] One author went so far as to say that because of their poor living conditions, "in many units, the death rate of middle-aged intellectuals has surpassed that of senile people."[16] And Lu Jiaxi, president of CAS urged that the middle-aged members of scientific ranks be relieved of the "four affairs" (professional affairs, administrative affairs, party affairs, and household affairs) and that efforts be made "to reduce the troubles in their daily lives."[17]

In the meantime, the regime is attempting to compensate scientists and engineers by recognizing their work achievements in ways that are not subject to public opinion. This is easiest to accomplish within the academic community and here the least expensive method is by conferring titles on research personnel. The prestige and recognition accrued through titles are much greater in China than in the West and, whenever appropriate, institutions are urged to confer "senior academic or technical titles commensurate with the levels" of the individuals.[18] The most expensive compensation, and the one most sought after, is housing. Because housing must be provided by work units which have limited funds for new construction, the government allocated a special fund of 100 million yuan for housing projects for senior scientific, technical, and educational personnel working under the Chinese Academy of Sciences, the Ministry of Education, the Ministry of Public Health, the Ministry of Culture and the State Commission of Physical Culture and Sports.[19]

Achievements are also recognized through prizes and bonuses for creative work. At the highest levels of science and technology this practice receives widespread attention. Since 1979, 1,426,000 yuan have been distributed to 552 scientists for their outstanding accomplishments, as recipients of either the Invention Award or the Natural Science Award.[20] The most recent awards ceremony was held in Beijing in July 1982, with prizes ranging from 1,000 to 10,000 yuan and a special award of 100,000 yuan for a research achievement "that contributes significantly to the development of the world's science and technology." Lesser awards are distributed within production and research units, but apparently they are not as prevalent as the leadership would like.

The practice of "slicing", however, tends to cut drastically the value of cash awards. The most glaring example of "slicing" was reported for the Zhejiang Provincial Academy of Agricultural Science, whose scientists received 91 awards since 1977:[21]

> In each instance, the political and administrative department took the first cut of 10 percent, then the service department took 12 percent, the information and library 3 percent, the research institute 15 percent, the farm 10 percent, and the rest went finally to the research team. After each member of the team took a share, the "hero" winner of the award was left with just about 10 percent.

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[15] *Liaowang (Observation Post)*, No. 7, July 20, 1982; JPRS, No. 81,811, Sept. 21, 1982.
[16] Ibid.
[17] Renmin Ribao (*People's Daily*) (RMRB), Sept. 23, 1982; FBIS, Sept. 30, 1982.
[18] Policy Research Office of the Chinese Academy of Sciences, "Chinese Academy of Sciences in 1980," unpublished paper.
[19] Ibid.
[20] *China Daily* (CD), Beijing, July 19, 1982.
[21] CD, Feb. 20, 1983.

Another example of unsound egalitarianism and bureaucratic inefficiency was given in the same source. For producing two up-to-date industrial turbines, the Hangzhou Turbine factory was awarded 2,700 yuan by the government. Rather than dividing the money among the workers responsible for this achievement, the factory took 5 (!) years and innumerable conferences and meetings, before finally dividing the money among 230 persons "more or less connected with the project, with the two major designers each getting only 50 yuan." As if this were not bad enough, the rest of the employees complained so bitterly, that the management was forced to take 7,000 yuan of its own funds "to buy each of the other employees a towel." Whoever said that Chinese workers were voiceless?

In his speech at the National Science Awards Conference on October 24, 1982, Premier Zhao Ziyang called attention to the need to do more in terms of giving recognition to the scientific research personnel. He said that although many workers, peasants, and managerial personnel have not invented or discovered anything, they did make a variety of important and creative contributions in science and technology at their work posts. The present system for checking on scientific and technical personnel and then rewarding them "is neither complete nor perfect," he said, stressing that such rewards should not come only on the initiative of the state, but also through recognition "by their own enterprises, regions, or departments." And in this connection he stated flatly that "egalitarianism should not be practiced." [22]

Who Controls Science?

Marx labeled science "a motive and revolutionary force in history"; Mao listed it as one of the three great revolutionary movements for building a mighty socialist state; Deng proclaimed that "the crux of the four modernizations is the mastery of modern science and technology." It is not surprising, then, that high-level officials, not underlings, become intimately involved with making science policy decisions. And yet, just as in the advanced nations—albeit for very different reasons—the question of who actually controls science is not easy to answer. Nevertheless, since policies with regard to scientific and technical manpower and education are an integral part of these decisions, it is a question we cannot ignore.

Mao's dilemma was that although he truly recognized the importance of science, he was ever suspicious of the scientists. He felt he could not allow scientists to "run science" because of the serious diversity between their individual interests and what he perceived to be China's national interest. Consequently, much of the instability in China's scientific establishment over the past three decades was caused by the perpetual battle over who should control it. The problem was clearly set out by Suttmeier in his analysis of how professional, bureaucratic, and mobilization models (and various mixtures of the three) have been competing with each other for the organization and administration of science.[23]

After the death of Mao, and especially after the much publicized National Science Conference of 1978, there was a basic change in the

[22] BR, No. 46, Nov. 15, 1982.
[23] Richard P. Suttmeier, *Research and Revolution*, Lexington Books, Lexington, Mass., Toronto and London, 1974, Ch. 4.

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official perception of science and technology—"the cutting edge of modernization." More important, the new leaders were anxious to make amends to the scientific and technical people for the suffering imposed on them by the Cultural Revolution. This compensation was done not only through public recognition of the essentiality of their contribution to China's development, but also by involving scientists in the formulation of the country's science policy. The State Science and Technology Commission (SSTC) was reestablished under the State Council; the Chinese Academy of Sciences (CAS) gradually resumed its responsibility for planning, directing, and supporting research; scientific associations and publications began to flourish once again; and scientists were assured that politics, which dominated science for so many years, would no longer interfere with their work. All this suggested that the long-standing battle for the control of science was finally nearing an end, but, although on a very different level, the debate continues.

In fact, the relatively free reign the leaders of science seemed to gain in 1978 and 1979 was short lived. Soon China launched her policy of economic readjustment, which included scrapping many of the programs only recently introduced. In this backtracking, science and technology were in no way sacrosanct. Many of the more venturesome and expensive projects, which while possibly enhancing China's world image would have contributed little toward easing the country's more pressing problems, were postponed or abandoned altogether. This belt-tightening was imposed no doubt despite strong protest by some of China's most prominent scientists, who were greatly influenced by colleagues from the United States and other developed countries.[24] In other words, in just a few years, political leaders came to the realization that if science and technology were to be brought "into the orbit of the plan for developing the national economy" (rather than "blindly strive to catch up with and surpass advanced countries"), some basic controls would have to be established by the leadership and applied to the scientific community.

With the greater freedom of expression now allowed on both sides of any issue, a lively debate has developed over how much "supervision" is enough. The gist of the argument, which is still going on, is what type of guidelines will assure science and technology's responsiveness to China's economic needs but, at the same time, will not hamper creativity or stifle innovation. The difficulties of this important problem can be illustrated by considering just two recent examples of the debate.

In order to make his plea for greater freedom for scientists, one author picked a seemingly innocuous title for his article: "On Distinguishing Persons With Scientific Talent." He manages to attack, however, both the local problems caused by incompetent cadres and the broader problems of scientific controls. Shi Xiyuan admits that there is a lot of shallow scientific research and that among some scientists there is "a tendency toward superficial pursuit of a quantity of articles." One reason for this, he claims, is the inadequate training of the science administrators who rule on this work; they simply do not know what is scientifically valuable and what is not. "Science tolerates failure but not deceit," he says, and good science can be distinguished

[24] See, for example, Leo A. Orleans, "Science, Elitism, and Economic Readjustment in China," *Science*, Jan. 29, 1982, pp. 472–477.

from bad science only through peer review. He points out that "some leadership comrades who have a feudal, special-privilege mentality, a heavy-handed workstyle, and a deficient ability to discriminate in scientific matters insist on controlling many things that they should not control." And finally, he calls for more flexibility in systems and policies which will give scientific workers more freedom and "make them genuflect less." [25]

A somewhat different tack is delineated in a 1980 article in the authoritative *Red Flag* journal entitled "A Talk on the Characteristics of the Scientific Labor." [26] With alternating bows toward scientific freedom and controls over science, it presents an approach which seems to correspond closely with the policy which is currently being pursued. To show his sympathy for scientific workers, the author acknowledges that scientific labor is not always productive and calls for a degree of flexibility; failures, too, contribute to science. He talks about the need for an environment in which the creative spirit can be brought into full play, noting that scientific exploration cannot be performed under duress since "no one can force anyone else to create anything new under the threat of sticks and lashes." Could he possibly be sincere when quoting Lenin to contrast the socialist system, which has "freed scientific labor from shackles," with the capitalist society in which the bourgeoisie holds tight control over scientific workers to "meet the needs of economic competition and military buildup."

The real message, however, is not polemical—it is quite precise. Despite the admitted uncertainty of scientific work, the author states unequivocally that, to be sure scientific research moves in the desired direction, "it is essential to reasonably allocate manpower, material, and financial resources and to work out a general plan for overseeing and inspecting the implementation of research projects." In other words, the leadership of the party over science should be strengthened in order to secure a balance between the personal interests of the scientists and the needs of the state. And, clearly, "the assumption that the time has come for every scientific worker to do whatever he wishes and that everyone can now enjoy the freedom to select his own profession is incorrect and unrealistic."

The conclusion of the *Red Flag* article—reiterated in similar statements made since then—is that "scientific workers do need freedom, but not a free journey into wild flights of fancy." This may be a reasonable maxim at the present stage of China's development, but who will make the final judgment as to whether a particular research project is of potential economic value or a "wild flight of fancy"? There are clear indications that from now on major scientific decisions will also have to be approved by planners and economists.

Although there have been no official organizational changes and, on paper, the SSTC, the State Planning Commission (SPC), and the State Economic Commission (SEC) continue to be co-equal under the State Council, controls over the scientific and technological hierarchy are being tightened. First, there were some rather explicit recommendations in science journals, such as the following in early 1981: [27]

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[25] *Ziran Bianzhengfa Tongxun (Journal of Dialectics of Nature)*, No. 1, 1981; JPRS, No. 79,194, Oct. 13, 1981.

[26] *Hung Chi (Red Flag)*, No. 12, June 16, 1980; JPRS, No. 76,296, Aug. 26, 1980.

[27] *Ziran Bianzhengfa Tongxun (Journal of Dialectics of Nature)*, No. 2, 1981; JPRS, 79,115, Oct. 1, 1981.

> The State Planning Commission should include a plan for science and technology as an integral part of the long-range plan for national economic development. Moreover, the plan for science and technology should be subordinated to the plan for national development . . . so that the two will be organically and closely bound together. . . State planning organizations ought to see plans for science and technology as their own business.

More than a year later, Premier Zhao Ziyang expressed this notion in a more diplomatic statement, when he stressed at the Fifth National People's Congress that from now on the SSTC must work with the SEC and the SPC in organizing and coordinating major projects for scientific and technical research.[28]

Despite Zhao's proclamation and similar intimations by others, any notion that the SSTC has been downgraded in its role as a coordinating body for all scientific and technological activities is officially denied. Nevertheless, in an informal conversation in Beijing (November 1982), one SSTC staff member admitted that the position of the SSTC has been "slipping" and that the leaders of the SSTC met recently to consider what might be done to reverse this trend. That problems may be arising between the SSTC and the State Planning and Economic Commissions could be presumed from yet another informal conversation with an SSTC official (January 1983). He said that China is now in the process of setting up a small group of high officials to adjudicate any problems that arise between the SSTC and the other two commissions.

In fact, the creation of the State Council Science and Technology Leading Group, with a much broader franchise than just indicated, was officially announced just three weeks later. The high level of this Group is evident from its membership. It is headed by Premier Zhao Ziyang, with Fang Yi, state councilor and minister in charge of the SSTC, and Song Ping, vice-minister of the SPC, as deputies. The Group will also include leading members of the SPC, the SEC, the SSTC, the Science and Technology Commission for National Defense Industry, the Academy of Sciences, the Ministry of Education and the Ministry of Labor and Personnel. In addition to making long-term plans for science and technology, studying science policy, making decisions on the importation and assimilation of technical know-how, the State Council Science and Technology Leading Group will also "coordinate the organization and management of scientists and technicians throughout the country" and "coordinate scientific work between various departments."[29] The creation of this Group has further emphasized and formalized the importance of science and ...inology in China and certified that the key decisions in these fields will be made by the very top of the leadership pyramid. It might also inadvertently defuse some of the local friction between researchers and managers. At least some unpopular research decisions at the institute and unit levels no longer need be blamed on the ignorance of the managers, but can be made less disruptive and easier to control by shifting the responsibility to the faceless hierarchy in Beijing.

[28] *Xinhua*, Mar. 8, 1982; FBIS, Mar. 9, 1982.
[29] *Xinhua*, Jan. 28, 1983, FBIS, Jan. 31, 1983.

RESTORING HIGHER EDUCATION—GROWING PAINS

Having borne the brunt of every political and ideological campaign since 1949, China's fragile educational system was completely devastated by the Cultural Revolution. Small wonder then, that more than three decades later, the country still must cope with problems which, under normal circumstances, would have been long since resolved. Once again plans are being developed to guarantee universal primary education. A provision for compulsory primary education has been incorporated into the latest version of the constitution. General middle schools, the source of university students, developed too rapidly in the immediate post-Mao period and are being deemphasized. Conversely, secondary vocational and technical schools, so highly developed in the 1950s and 1960s but rendered unnecessary by the reduced standards in colleges in the 1970s, are being expanded and strengthened. Television, radio, correspondence, and other schools designed for continuing education are expanding rapidly. But the greatest problems and the most drastic changes are occurring in the institutions of higher education—the focus of this report. After all, the Cultural Revolution virtually destroyed higher education: the institutions were closed for some 4 years and, in the subsequent 6 years, political rather than academic qualities of the students and the curricula were emphasized. The result is a serious lack of trained professionals, especially engineers and scientists, which consequently stalls the rate at which China can expect to modernize her economy and society.

Thus, since 1977, and especially in more recent years, China has again been in the throes of "readjustment, restructuring, reorganizing, and upgrading" the entire educational system. Teaching methods must be re-evaluated, curricula must be revised, faculty must be strengthened, facilities must be improved, and all this must be done within a limited budget and with both quantity and quality of education in mind. One need not necessarily fully understand the meaning of the Chinese philosophical maxim that "quantity and quality are two opposites in unity," to appreciate the basic dilemma of educators and planners: how to improve the quality of higher education without disregarding quantity but, concomitantly, increase the number of students without lowering educational standards.

In the meantime, the number of institutions of higher education has been increasing annually, reaching 704 in 1982. Of this total, 186 are usually referred to as junior colleges or training schools. The breakdown for the remaining 518 institutions is as follows: 32 comprehensive universities, 207 industrial colleges (sometimes referred to as colleges of sciences and engineering), 55 agricultural colleges, 10 forestry colleges, 112 medical colleges, 186 teachers colleges (normal schools), 10 language and literature colleges, 36 financial and economic colleges,

7 political science and law colleges, 12 physical education colleges, 27 art colleges, and 10 colleges for nationalities (sometimes listed simply as "others").[30]

With the growth in the number of colleges it was necessary to introduce some standardization into the system. One of the primary innovations in 1981 was to put into effect for the first time an academic degree system. Closely following the American model, China instituted a system of bachelor's, master's and doctoral degrees in 10 fields: philosophy, law, literature, history, economics, education, science, engineering, agriculture, and medicine. The Academic Degree Committee of the State Council which directs the awarding of degrees nationwide, has empowered institutions of higher learning and the relevant research institutes to establish degree evaluation committees, to organize thesis and dissertation defense committees, and to implement the actual work of conferring degrees.[31]

On the whole, however, what is emerging is an extremely diversified approach to education which, under Mao, would have been described as "walking on two legs." The diversification applies to all levels but is most evident at the higher level. There are regular universities and key universities, which admit the most promising students and provide them with the best possible education (see Appendix A). There are colleges under the Ministry of Education and those run by provinces, other ministries, and other institutions. There are full-time college students and those who complete a form of higher education through the rapidly expanding system of continuing education. And, finally, there are regional differences, for, as is true in the implementation of all policies and regulation, each locality is encouraged to make adjustments that take into account local circumstances. The administrative breakdown for the institutions of higher education is presented for 1980 in chart 1.

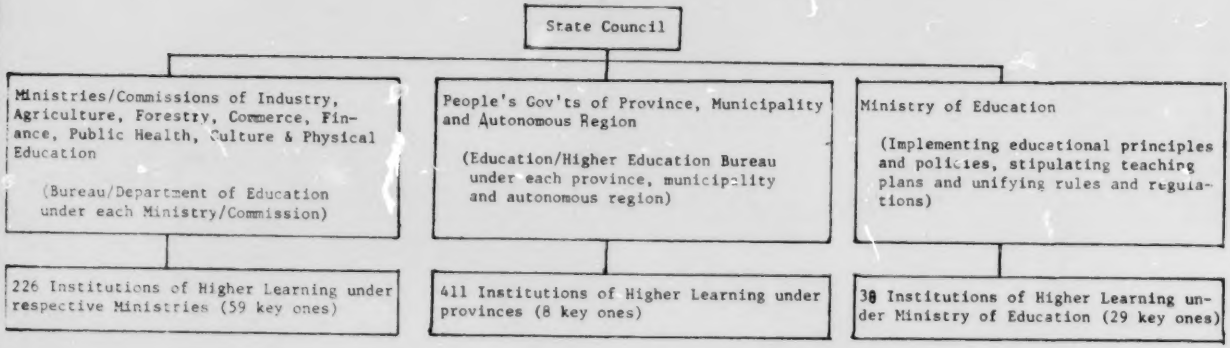
The diversity is likely to be accentuated even further by an ambitious World Bank project to assist the Chinese Government in improving both undergraduate and graduate education in science and engineering in 26 key universities, selected on the basis of current size of enrollment in these disciplines, faculty qualifications, and geographic location. Briefly, the objective of this project is to increase enrollment and improve the utilization of staff and space; to raise the quality of graduates and research work by improving staff quality and modernizing laboratory equipment and facilities; and to strengthen management and record-keeping at both the Ministry of Education and university levels. With some $300 million to spend and with some of the world's foremost scientists and educators on call, the 26 universities selected for Bank assistance should, within a few years, show considerable improvement in the quality of graduating scientists and engineers.

All this may make eminently good sense for a country which must improvise in order to match large requirements with limited capabilities, but the lack of uniformity makes it extremely difficult to generalize when describing any aspect of the education system. How, for example, does one analyze quality, when college training can last any-

[30] *Liaowang (Observation Post)*, No. 5, May 20, 1982; JPRS, No. 81,811, Sept. 21, 1982.
[31] BR, No. 4, Jan. 24, 1983.

Chart 1

SYSTEM OF MANAGEMENT OF INSTITUTIONS OF HIGHER LEARNING IN CHINA


State Council
Ministries/Commissions of Industry, Agriculture, Forestry, Commerce, Finance, Public Health, Culture & Physical Education
(Bureau/Department of Education under each Ministry/Commission)
People's Gov'ts of Province, Municipality and Autonomous Region
(Education/Higher Education Bureau under each province, municipality and autonomous region)
Ministry of Education
(Implementing educational principles and policies, stipulating teaching plans and unifying rules and regulations)
226 Institutions of Higher Learning under respective Ministries (59 key ones)
411 Institutions of Higher Learning under provinces (8 key ones)
30 Institutions of Higher Learning under Ministry of Education (29 key ones)

NOTE: 675 Institutions of Higher Learning, of which 96 are key ones (1980). Since 1980 the total number has increased to over 700.

Source: The Chinese Education Association for International Exchanges, 1980.

where from 2 to 5 years? A graduate of a provincial 2-year teachers college is in no sense comparable to a graduate from a national 4-year key university, and yet there are no statistics to separate them. And what decisions is China making with regard to various problems facing education? Some answers are given in official proclamations by the Ministry of Education or by senior members of the state and party hierarchy, but at the same time there is a multiplicity of views on the same subject expressed in articles, editorials, and other published materials, written by individuals with an unknown degree of authority. Most likely, this freedom of expression—seemingly more evident in the field of education than in most others—reflects both the serious problems extant, and Beijing's indecision as to how to resolve them. In other words, China's education is in a state of flux—and it has been forever thus.

This discussion picks up the story of higher education in the late 1970s. It starts by reviewing the available statistics, and with this perspective goes on to discuss the specific problems and how they are being coped with—regional diversity notwithstanding. Since students in engineering and the sciences (including social sciences) constitute some two-thirds of the total enrollment in higher education, and since their education is of primary concern to the authorities, most of the issues discussed, even if not specifically mentioned, apply most directly to these students.

The Statistical Perspective

Table 1 assembles some of the figures that are currently available on the higher education entrants, enrollment, and graduates since 1976. As in previous years, any statistical compilation for China continues to require caveats.

China has yet to publish a single compilation of statistics on higher education (see Appendix B). As is evident from the table, to assemble relevant figures, they must first be culled from speeches, news reports, and various articles. There is no doubt that the quality of Chinese statistics has improved in the past few years. Nevertheless, although the range of reported figures is narrower than it once was (whether because of liberal rounding, unexplained inclusions or exclusions, simple sloppiness, or for other reasons), it is usually possible to find several varying "official" figures for the same category. For example, if the Finance Minister says that there were 314,000 entrants into the institutions of higher education in 1982 and the New China News Agency reports the number as 355,000, which do you accept? Or, a much easier choice: which do you accept when three "official" numbers of graduates are reported to be 310,000, 311,000 and 317,000 for the same year? And, are students attending military institutions of higher education always, sometimes, or never included? They are seldom mentioned, and although their number is relatively small, it is large enough to create confusion in the statistics. The problem can be seen from one stray report that in 1980 the "institutions of higher learning will enroll 270,000 students and the military academies and schools will recruit a little more than 15,000, with a total of more than 285,000."[32] Since these were planned figures and the actual number of entrants reported for 1980 was 281,200, shall we assume that the regular colleges ex-

[32] Xinhua, Aug. 4, 1980; FBIS, Aug. 7, 1980.

ceeded their quota, or that the combined civilian and military schools did not quite reach the projected total?

In preparing the table, if more than on figure was available for any year or category, usually the one selected was the least rounded, came from the "more official" source, and made the most sense in terms of compatibility with other data. And it is appropriate that the final caveat come from China: "At present, the explanations of terms concerning the status of students in institutes of higher learning found in some documents, publications, and propaganda reports are not consistent, are unclear and confusing." [33] This applies to statistics as well as status.

Table 1 shows a fairly steady expansion of the higher education system, but a few comments may be useful. On the face of it, the enrollment of some 900,000 students in 1978 appears to be completely out of line, but there is an explanation. Previously presumed and only recently confirmed, this total includes those who passed the first post-Cultural Revolution college entrance examinations, given in October 1977, as well as those who passed the second set of examinations administered in July 1978—one group enrolling in March and the other in September 1978. Some figures which show a lower entrance total for 1978 probably refer to just one of the two groups, especially since the larger figure is adequately confirmed by the 311,000 graduates in 1982—four years later. The lower number of graduates for 1979, 1980, and 1981 resulted from the extension of the curriculum to four years

TABLE 1.—ENTRANTS, ENROLLMENT, AND GRADUATES OF THE INSTITUTIONS OF HIGHER EDUCATION IN THE PEOPLE'S REPUBLIC OF CHINA SINCE 1976

Year	Entrants	Enrollment	Graduate	Number of institutions
1976		[a] 564,000		[a] 392
1977	[b] 278,000	[c] 625,000	[d] (117,900)	[c] 404
1978	[e] 400,000	[c] 856,000	[f] 166,000	[c] 598
1979	[g] 275,000	[c] 1,020,000	[h] 162,000	[c] 633
1980	[i] 281,200	[a] 1,143,700	[a] 146,600	[a] 675
1981	[j] 278,800	[a] 1,279,500	[j] 139,600	[a] 704
1982	[j] 314,000	[k] 1,140,000	[j] 311,000	[m] 719
1985 (projected)	[k] 400,000	[k] 1,300,000		
1990 (projected)	[k] 600,000	[k] 2,000,000		

[a] Xinhua, Aug. 25, 1982, in FBIS, Aug. 27, 1982. In 1981 there were 518 universities and colleges with 1,060,700 students and 186 junior colleges with 218,800 students (*Gaojiao Zhanxian*) (*Higher Education Front*), No. 3 March 1982, in JPRS No. 82,127, Nov. 11, 1982).

[b] NCNA, June 13, 1978.

[c] *Main Indicators, Development of the National Economy of the People's Republic of China (1949–1979)* State Statistical Bureau, Beijing, 1980.

[d] Total number of graduates between 1977 and 1980 was reported to be 591,000. By substracting independently reported number of graduates for 1980, 1979, and 1979, we derive the total for 1977. This low total appears reasonable because many students were held back for additional training.

[e] Beijing, Zinhua, June 30, 1979.

[f] *Peking Review*, No. 43, Oct. 27, 1978.

[g] *Recent Development of Education in the People's Republic of China (1979–80)*, The Chinese Education Association for International Exchanges, April 1982, p. 2. Of the total enrollment, 338,000 are in teachers' colleges and normal universities.

[h] Beijing, Xinhua, July 2, 1979.

[i] *Gaojiao Zhanxian (Higher Education Front)*, No. 3, March 1982, in JPRS No. 82,127, Nov. 1, 1982.

[j] Xinhua, Dec. 14, 1982 (in a budget report by Finance Minister Wang Bingquian).

[k] RMRB, Nov. 18, 1982 (by Deputy Minister of Education, Huang Xibin).

[l] Xinhua, June 15, 1982, in FBIS June 16, 1982.

[m] Xinhua, August 15, 1982.

[33] *Gaojiao Zhanxian (Higher Education Front)*, No. 1, Jan. 1982; JPRS, No. 82, 440, Dec. 10, 1982.

for most of the students already in the universities. The year 1979 presents a special problem. According to information provided by the Ministry of Education to the World Bank,[34] the total number of graduates in that year was an incredibly low 85,000. It is certainly possible to speculate that the authorities held back a larger number of students than previously assumed, especially since 28 percent of the graduates were from the mostly 2-year teachers colleges. But although it may seem presumptuous to question such an authoritative source, until additional confirmation becomes available, for inclusion in table 1, a larger number reported by the New China News Agency was selected. Finally, the reader should be reminded once again that the figures in this table include students who attended college anywhere from 2 to 5 years, so that, for example, of the 270,000 graduates of higher education in 1982, "more than 160,000 completed 4 years of college and over 100,000 took 2 or 3 years courses".[35] This makes it impossible to draw more than tenuous inferences about the usual numerical interrelationships between entrants, enrollees, and graduates in the various years.

The projected growth in China's higher education was included in the Sixth Five-Year Plan (1981–85) and appears to be quite realistic. By 1985 the number of entrants into higher education should increase from 180,000 in 1980 to 400,000; total enrollment should reach 1.3 million; and the number of graduates over the 5-year period is expected to be 1.5 million. By 1990 China hopes to admit 600,000 new students and have a total college enrollment of about 2 million.[36]

Between 1963 and 1979 the Chinese did not publish a single set of figures on the distribution of university students by field of specialization—whether in terms of entrants, enrollment, or graduates. The appearance of some data for the more recent years is therefore most welcome and is presented in tables 2 and 3.

TABLE 2.—ENROLLMENT IN INSTITUTIONS OF HIGHER EDUCATION BY FIELD OF SPECIALIZATION

[Numbers in thousands]

	1979 [a]		1980 [b]		1981 [c]	
	Number	Percent of total	Number	Percent of total	Number	Percent of total
Engineering	346.0	33.9	382.0	33.4	461.3	36.0
Agriculture	69.0	6.8	71.6	6.2	78.8	6.2
Forestry			11.8	1.0	13.6	1.1
Medicine and pharmacology	127.0	12.4	139.6	12.2	159.0	12.4
Teacher colleges	311.0	30.4	338.3	29.6	321.5	25.1
Liberal arts	63.0	6.2	58.7	5.1	69.1	5.4
Science	70.0	6.9	83.7	7.3	99.8	7.8
Finance and economics	22.0	2.2	36.6	3.2	47.9	3.7
Political science and law	3.0	.3	6.1	.5	10.0	.8
Physical education	9.0	.9	9.4	.8	11.2	.9
Arts			5.9	.65	7.3	.6
Total	1,020.0	100.0	1,143.7	100.0	1,279.5	100.0

[a] *China: Socialist Economic Development*, Annex G: Education Sector, The World Bank, June, 1981. The absolute figures were reported by the Ministry of Education, the percentage distribution was calculated.
[b] *Zhongguo Baike Nianjian 1981* (Yearbook of the Encyclopedia of China), Beijing/Shanghai, 1981, p. 474.
[c] *Gaojiao Zhanxian (Higher Education Front)*, No. 3, March 1982, in JPRS No. 82,127, Nov. 11, 1982.

[34] The World Bank, *China: Socialist Economic Development*, Annex G: Education Sector, June 1, 1981, p. 35.
[35] Xinhua, Jan. 15, 1982; JPRS, No. 79,954, Jan. 27, 1982. The total was later reported as 311,000 (table 1).
[36] BR, No. 6, Feb. 7, 1983.

TABLE 3.—GRADUATES FROM INSTITUTIONS OF HIGHER EDUCATION BY FIELD OF SPECIALIZATION

	1980 [a]		1981 [b]	
	Number	Percent	Number	Percent
Engineering	44,000	30.0	12,195	8.7
Agriculture	4,200	2.9	7,902	5.6
Forestry	1,200	.8	933	.7
Medicine and pharmacology	17,700	12.1	9,512	6.8
Teacher training	61,800	42.1	103,422	74.1
Liberal arts	6,400	4.4	1,210	.9
Science	8,500	5.8	1,989	1.4
Finance and economics	1,200	.8	2,079	1.5
Political science and law	100	.1		
Physical education	1,000	.7	73	.1
Arts	500	.3	321	.2
Total	146,000	100.0	139,640	100.0

[a] *Zhongguo Baike Nianjian 1981 (Yearbook of the Encyclopedia of China 1981)*, Beijing/Shanghai, 1981, p. 474.
[b] *Zhongguo Tongji Nianjian 1981 (Chinese Statistical Yearbook* 1981), Hong Kong, 1982, p. 446.

Despite political fluctuations and changes in total enrollment, earlier data and occasional spot figures reveal considerable stability over the years in the proportion of the student body enrolled in specific broad majors—a stability which continuously overemphasized the training of engineers and scientists.[37] This problem was summarized by Fang Yi, when he said: "For many years there has been a lopsided development of science and engineering departments in the institutions of higher learning, with the result that the training of professionals in liberal arts, law, and business departments has been seriously neglected." [38] So far, however, because of national requirements and student preferences, there has been no decrease in these categories. Beijing is not characteristic of China, but among the 92,200 young people who took the college entrance examination there in 1982, 64,700 listed science as their first choice for a college major.[39] Thus, although China is in the process of expanding the departments responsible for the training of social scientists, the slow increase has been taking place at the expense of teachers' training, but which still continues to have the largest enrollment next to engineering. It should be remembered, however, that most of the teachers of primary and even rural junior middle schools are graduates of secondary teacher training schools, which enroll graduates of junior middle schools for a period of 3–4 years. The authorities are attempting to upgrade the qualifications of these teachers, but it will be a slow process, especially in the countryside.

But while enrollment figures have remained relatively stable, table 3 shows an acute shift in the distribution of graduates between 1980 and 1981. As discussed earlier, the 1981 figures suggest that a large number of college students were held back for additional education and only those completing the 2-year curriculum in teachers and agricultural colleges were not delayed in their graduation. Within a few years, however, the distribution of graduates should once again more closely reflect the distribution of enrollment.

[37] See, for example, Leo A. Orleans, *Manpower for Science and Engineering in China*, Committee on Science and Technology, U.S. House of Representatives, June 1980.
[38] Xinhua, June 6, 1980; FBIS, June 9, 1980.
[39] CD, July 7, 1982.

It would be nice to have a breakdown for the majors combined in tables 2 and 3: medicine and pharmacology, finance and economics, and political science and law. The reason they are lumped together is that specialized colleges combine these disciplines (see earlier listing) and for general purposes do not report separate totals for the schools. On the basis of an informal comment made by a member of the Chinese Academy of Medical Sciences and some employment figures, it would seem that pharmacology majors represent about one-tenth of the medicine and pharmacology category. One specialist on Chinese law estimates that there were approximately 6,000 law students in China in 1982, or about half of the political science and law category.[40]

It is interesting to consider the proportion of students in each field of study who are attending specialized institutions of higher education as opposed to comprehensive universities. From the information contained in two tables in the *Statistical Yearbook of China 1981* [41]—one giving enrollment by type of institution and the other by major—it is possible to calculate that in 1981 some 86 percent of students majoring in science and engineering attended colleges specializing in science and engineering, while the other 14 percent studied these subjects in comprehensive universities. Among the majors with the highest proportions in special institutions are medicine (99.8 percent), teacher training (98.3 percent), physical culture (96.4 percent), and the arts (84.9 percent). Forestry, finance and economics, political science and law, fall at approximately 75 percent, but only 11 percent of students majoring in liberal arts go to special colleges, which means that almost 90 percent of them attend comprehensive universities. The one anomaly is agriculture. Curiously, the number of students attending agricultural colleges is higher than the total number of students majoring in agriculture (86,400 versus 78,800), which would suggest that 7,600 students in agricultural colleges major in something other than agriculture, implying that agriculture is the only major that is entirely omitted from comprehensive universities. This is not impossible, but it should be explained.

Enrollment Issues and Selection Problems

In order to raise the qualitative level of higher education, China's first priority was to raise the academic level of new entrants. For the first 6 years after the Cultural Revolution, academic achievement was not the primary consideration for higher education. Instead, graduates from middle schools (themselves reduced to 3–4 years) first had to spend 2–3 years on a farm or in a factory and then had to receive a recommendation from their work unit, vouching for their class background (worker, peasant, or soldier), their work performance, and their enthusiasm for the particular brand of socialism which was in vogue at that time. Consequently, most of the college entrants from 1970 through 1976 were not only poorly prepared for higher education, but had forgotten much of what they had learned prior to their work stint.

[40] This estimate was suggested to the author by Dr. Tao-tai Hsia, Chief of the Far Eastern Law Division, Library of Congress.
[41] State Statistical Bureau, *Statistical Yearbook of China 1981* (English Edition), Hong Kong, 1982, pp. 455 and 456.

The return in 1977 of the system of competitive examinations which existed between 1949 and 1966, created a crush of prospective students. New graduates from middle school competed with older individuals who were denied the opportunity to go to college before or who were turned down for non-academic reasons, so that in 1977, 1978 and 1979, the number of applicants taking college entrance examinations exceeded 5 million.[42] To conduct an examination of this kind for so many participants was inefficient and expensive. Inevitably, many mistakes were made in grading the tests and selecting the best students. In 1980, the State Council stipulated that provinces and municipalities should hold preliminary examinations to reduce the number taking the "national unified examinations" by weeding out the weakest applicants at the local levels. By 1980, the number taking the exams was reduced to 3.3 million and by 1982 it was down to about 2.0 million [43]—the overwhelming proportion of them current graduates from middle schools. This has somewhat eased the problem of administering the tests, but it has not reduced the throngs of students attempting to get into college.

The reason for the continuing crush has to do with Chinese culture and society, exacerbated by developments in the educational system in the earlier 1970s. In China for an offspring to get into college is a matter of both family prestige, upward mobility, and improved old-age security. The competition is incredible and the consequences of failure may be traumatic, especially for the children of intellectuals. There are cram courses before the examinations, stories of bribery and cheating, and even suicides among those who fail. Chinese parents in the urban areas strive to get their children into the key primary schools and key secondary schools—almost a prerequisite for passing the college entrance examinations. As one deputy to the National People's Congress expressed it, "Education in middle and primary schools is lopsidedly aimed at raising the proportion of students who can pass entrance examinations into higher schools . . . This has led to many bad consequences." [44]

In the past year there has also been some criticism of the excessive reliance that is being placed on college entrance examinations, because although the system under which "everyone is equal before the entrance examination marks" is reasonable, it overlooks many promising youths. It is now suggested that in order for all talented youths to get an opportunity for college, examination grades should (again?) be combined with recommendations.[45] In the meantime, still only a fraction of the several millions who take the entrance examination make it into college.

The factor within the education system which has accentuated the problem and which leaves many young people disillusioned, is the unevenness in the development of higher and secondary education. This was not always the case in China and some instructive background information was provided by Jiang Nanxiang, formerly the

[42] For a detailed description of the 1978 examination, including sample exams, see Robert D. Barendsen, Ed., *The National College Entrance Examination in the People's Republic of China*, Office of Education, Washington, 1979.
[43] CD, July 7, 1982.
[44] Xinhua, Dec. 8, 1981; FBIS, Dec. 12, 1981.
[45] BR, No. 3, Jan. 17, 1983.

Minister of Education. During six of the years in the decade of the 1950s, the number of university slots exceeded the number of students graduating from middle schools, while in the other four years, the percentage going on to higher education was between 80 and 90 percent. In the 1960s, the number of senior middle schools grew and the proportion of graduates going on to higher education decreased to 30–40 percent. During the 1970s, rural and vocational middle schools were "smashed" and technical middle schools were weakened, while the general senior middle schools (the source of college entrants) were "rashly popularized." As a result, although between 1965 and 1980 the number of entrants into higher education increased from 165,000 to 281,000, the number of senior middle school graduates increased much more drastically, from 360,000 to 6,160,000, thus dropping the admission rate from 45 to 4 or 5 percent.[46]

Beijing is following several approaches to correct the disproportion between middle and higher education and to pacify the restless youth. At the secondary level, the correction calls for shifting the balance from general middle schools to "various kinds of vocational middle schools."[47] This would reduce "the narrow path" to college admission; it would let students know at an earlier age, and before the intense trauma of preparing for the entrance examinations, that they are not slated for college; and it would increase the number of sorely needed middle level technical personnel. While at the local levels the Chinese have been reporting striking successes,[48] at the national level the progress has been slow. The enrollment in the secondary general schools has decreased as prescribed from 65.5 million in 1978, to 59.1 in 1979, to 55.1 in 1980 and to 48.6 in 1981, but the increase in the vocational schools has been relatively modest, from about 1 million in 1978 to perhaps 2 million in 1981. The "about" and "perhaps" that precede these figures reflect the definitional and statistical confusion that seems to exist in this particular sector of the educational system. Only if we (incorrectly) include the 8.2 million people in the technical schools for workers, staff members, and peasants and the spare-time secondary school enrollment can we approach an explanation for the 18 million reduction in secondary general education against the 1 million increase in the secondary vocational edu-

[46] *Wen Wei Pao*, Hong Kong, Dec. 17, 1981: JPRS, No. 79,892, Jan. 19, 1982. The flatness of this educational pyramid is graphically reported by Hu Ping in the following ratios for higher, secondary and primary education in 1980: 1:50:128, or, in absolute figures, 1,143,000 : 57,400,000 : 146,000,000. ("Education and Development of S&T Personnel," paper presented at the Joint US-China Science Policy Conference, Washington, D.C., January 9–12, 1983.)

[47] There is little confusion with regard to the general middle schools, or academic schools, which are comparable to our high schools. Other middle-level schools, however, can be quite confusing, so that the following definitions from *Beijing Review* (No. 42, Oct. 18, 1982, p. 24) may be useful:

—Secondary technical schools train middle-level professional personnel, such as accountants and nurses. At present, the programs adopted by such schools are varied: some enroll junior middle school graduates for four years; some enroll senior middle school graduates for two or three years of training.

—Workers' training schools train middle-level technical workers, such as carpenters and welders. Currently they enroll mostly senior middle school graduates for two years' training.

—Vocational (technical) schools train skilled workers and workers with special skills, such as chefs, tailors and photographers for one, two or three years.

Come to think of it—this doesn't help too much, either.

[48] In Jinzhou (Liaoning Province) there was an increase from only 7 percent enrollment in vocational courses in 1978 to 43 percent in 1982; in Qingdao (Shandong Province) over 30 percent of the secondary enrollment is now in vocational schools. (*China Reconstructs*, Sept. 1982).

cation. Fortunately, since this is a diversion from the main focus of this paper, we can drop the subject without further speculation.

Another reform which has just recently been introduced is meant to accomplish two very important objectives: increase the number of college students from smaller towns and rural areas and increase the number of sorely needed specialists with higher education in these localities. According to Huang Xinbai, the Vice-Minister of Education, starting in 1983 college entrance requirements will be lowered for students from rural areas who will be willing to major in agriculture, forestry, medicine or teaching and commit themselves to return to their native places after graduation.[49] Given this opportunity, it is reasonable to expect that large numbers of youths, who otherwise could never be accepted into institutions of higher education, will be entering colleges. Since the pool from which these students will be selected is extremely large and only the best will be selected, their academic background should not hamper their progress in the colleges of agriculture, forestry, or teaching. It does seem, however, that either special curricula or special departments might have to be established for rural students entering medical education.

Let us now turn to the readjustments that are taking place at the higher educational level to accommodate larger numbers of students. Because of shortages in building, teachers, equipment, and so forth, the Chinese recognize that the speed at which the more formal higher education sector can be expanded is limited. Alternatives are being considered. For example, one of the innovations currently being tested is the shift from the exclusive notion that colleges must board their students to the idea of enrolling day students who commute to school. This does not alleviate the pressures on classrooms and teaching facilities, but it does decrease administrative costs and saves on dormitory space. In Be jing, for instance, where in 1980 36 universities enrolled 14,440 day students, it is estimated that resident students require eight times more floor space than day students.[50]

Outside the formal higher education sector, a variety of approaches are being attempted to expand post-secondary education by "opening more avenues and using flexible dynamic methods." Flexibility is indeed the keystone in this type of education, and aspiring university students who do not pass their college entrance examinations, as well as workers and some peasants ineligible for the test, are encouraged to take advantage of continuing educational opportunities. Compared to regular universities, part-time educational institutions represent a tremendous saving to the Chinese Government. Tongji University of Shanghai, for example, estimated that a full-time student costs the government 2,200 yuan, while for the same unspecified period, correspondence students cost only a little over 100 yuan each.[51] The quality of the merchandise is by no means the same, but the cheaper product may provide better per yuan value.

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[49] Xinhua, Jan. 22, 1983: JPRS, No. 82,897, Feb. 17, 1982.
[50] BR, No. 30, July 28, 1980.
[51] Xinhua, Apr. 24, 1980: FBIS, Apr. 25, 1980. Other figures are suggested by other sources: for example: figures for Beijing University reveal that it costs the state 8,000 to 10,000 yuan to finance the education of a four-year resident student at that institution, while it costs only 400 to 800 yuan to support a commuting student, and only 150 yuan to support a correspondence student. (BR, No. 4, Jan. 24, 1983.)

The nonformal education at the tertiary level represents a motley mosaic of multiform management. There are TV and radio courses, correspondence courses, spare-time universities, and variations and combinations of these, run by provinces, towns, factories, local educational bureaus, regular universities and other institutions. The Chinese authorities place special emphasis on Radio and TV Universities (RTVU), which were formally reopened in February 1979. Twenty-eight provinces now have their own RTVUs and there are over 400 "branch schools" and 15,000 "grassroot units," where actual classes are held. To enter the RTVU, students have to take a competitive examination. If successful, they are released by their work unit to study full time, while continuing to receive full pay and medical care. At the end of three years (and surely not all take the full-year course), they take another examination and, if successful, they receive their diplomas and return to their original work unit. In the past three years, 800,000 students were enrolled in RTVUs, of whom 78,000 have graduated and 140,000 have completed specialized courses.[52] In 1983, 360,366 students were studying full time "in what may be the most far-flung university in the world."[53] The gross figures are indeed impressive and there is no doubt that many workers and staff people are improving their qualifications because of the training they receive through the TV universities, but it would be surprising if many of them would be passing the special examinations that are to give them college equivalency. Perhaps that is why such figures are not published.

There are even so-called private colleges now in some of China's major cities, although in fact they simply represent a more intensive utilization of existing college facilities, by providing education for pay to those who were unable to get in through regular channels. In 1980 colleges in Shanghai accepted 3,000 students, who, for a price of 20 to 25 yuan per semester, were able to use the existing facilities (and presumably the college staff) on weekends and at other times when such facilities remained unused.[54] Most of the private schools, however, use retired teachers and workers and concentrate on vocational training courses for readily marketable skills.

Although some Chinese officials insist that the graduates of adult institutions are equivalent in education to the graduates of regular universities, this is obviously not so. If they were, there would be no reason for their being excluded from the annual number of college graduates—which they are. The Ministry of Education did, however, recently set up a national examination committee which administers nationwide tests for "graduates from schools run by units without license from the Ministry," and then awards diplomas to those pasing the tests.[55] Although 10,000 young people have already taken this test in Beijing, the number who passed was not reported. As a brand new practice, it is too soon to tell whether diplomas from adult college education courses will carry the same weight as those of regular graduates and whether the recipients eventually will be included in the overall number of university graduates.

[52] BR, No. 6, Feb. 7, 1983.
[53] CD, Feb. 26, 1983.
[54] Xinhua, Jul. 29, 1980 ; FBIS, Jul. 29, 1980.
[55] BR, No. 6, Feb. 7, 1983.

Curriculum

Since 1976, the priority task at all levels of the educational system has been to revise and update teaching syllabuses and teaching materials. The problem was most acute and difficult at the university level, especially in the fields of science and engineering, where the return to the 4- or 5-year curriculum required drastic changes in the out-of-date texts, the standardization of the national curricula, and the re-incorporation of theoretical courses which were, for the most part, eliminated under the radical leadership. There is no doubt that impressive progress has been made, but, as is usually the case, it has been uneven. Furthermore, new issues have surfaced with regard to the curriculum which are still being debated.

One of the most frequent complaints in China has to do with the narrowness of the individual courses of study. One facet of this rigidity was discussed at a panel meeting on education by deputies of the National People's Congress, where a participant lamented that "often a student majoring in physics does not understand chemistry." [56]

Another negative aspect of the restrictive system was recently brought out by Su Buqing, a noted mathematician and professor in Shanghai's Fudan University, when he focused on the need to teach liberal arts to science and engineering students. Su complained that some students think scientists have no need to learn literature and history. Many students enrolled in this most prestigious engineering college, he revealed, failed to pass their Chinese language examinations and were unable to write a logical and coherent graduation thesis. The neglect of liberal arts among science and engineering students has attracted the attention of government officials. As a result, a number of universities are introducing courses in Chinese language and are even encouraging students to study basic music theory, traditional Chinese painting, literature and other optional subjects. [57] It should be pointed out, however, that for practical reasons, these changes would surely be limited to only a few of the key comprehensive universities. It will be a long, long time before the more specialized colleges will be offering art and music appreciation courses to their students.

Other educators are devoting their efforts toward solving what they perceive to be a much more basic problem: the continuing inadequacy of theory in the science and engineering curricula. One such observer stressed that because of the greatly shortened "knowledge-obsolescence cycle"—now only 5 to 10 years as opposed to 30 years in the 1800s and 80 to 90 years in the 17th century—"only by letting students master broad and profound basic theories and basic knowledge will it be possible for them to adapt more smoothly to the daily changing new situations after graduation." Science has advanced ahead of production, he said, and only if higher education advances ahead of science will students be able to adapt to and promote the advancement of both science and production. [58]

Yet another argument takes a completely opposite approach—actually pleading for narrowing the scope of the engineering curricula, because it is a "waste of talent" to give everyone a comprehensive course

[56] Xinhua, Dec. 8, 1981; JPRS, No. 79,777, Jan. 4, 1982.
[57] BR, No. 3, Jan. 17, 1983.
[58] GMRB, Aug. 5, 1980; JPRS, No. 76,927, Oct. 2, 1980.

in engineering. Contending that the new emphasis on theory is creating a weakness in manufacturing trades and vocational skills, some educators are urging that junior colleges be established to train students in manufacturing engineering and in production crafts.[59] Indeed, a survey of 140 engineering colleges revealed that in 1982 only 4 percent of the class time was spent on practical courses. As a result, the study concludes, many students "possess little ability to use their hands; their ability to solve real problems is poor; and their adaptability is not strong." [60] Apparently this criticism was taken seriously and some two years later China established locally funded 2-year vocational colleges, enrolling mostly day students, and training them in "middle-level (or higher) professional skills." [61]

As part of the effort to introduce flexibility into the Chinese higher educational system, the authorities are experimenting with a credit system similar to that in the United States and other Western countries. As one professor in Shanghai pointed out, it is wrong to "cut everything with one knife." The introduction of credits will make it possible for weaker students to take fewer courses and an extra 6 to 12 months to graduate, while brighter students should be able to exercise their talents (especially in the upperclass years) and complete their education in fewer than 4 years.[62] Another innovation being tested is based on the recognition that most graduates of middle schools don't really know what field they wish to pursue and therefore should have the option to postpone the selection of a specific specialty until they have completed some basic courses within a college or a department.[63]

Some educators are also beginning to recognize that the standard Chinese teaching method which values memorization is not only "rigid and devoid of liveliness," but actually stifles imagination and initiative. Current teaching methods rely on lectures, and students don't know how to do independent research or how to use reference materials. "In China . . . students concentrate their efforts only on assimilating what is taught in class," which "limits their outlook and affects the development of their ability to think independently." [64]

In the final analysis, the criticism and the problems just discussed support exactly the kind of diversification in higher education that the Chinese are pursuing. At one extreme there will be highly trained scientists and engineers who have had the luxury of art appreciation; on the other extreme there will be "welding engineers" who were unable to take any electives at all; and in the middle there will be science and technology graduates at every imaginable level of competence. One Chinese observer posited that it would be wrong for China to move from the Soviet model, which is too narrow to the American model, which is too broad, and suggested that the Japanese model would be "just right." [65] It seems quite clear however, that in the final analysis, the structure and content of institutions of higher education will be an amalgam of the Soviet, American, European, Japanese, and Chinese models—whatever they might be.

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[59] GMRB, Apr. 26, 1980; JPRS, No. 75,962, June 30, 1980.
[60] GMRB, Dec. 10, 1981; JPRS, No. 79,938, Jan. 26, 1982.
[61] BR, No. 6, Feb. 7, 1983.
[62] *Jiefang Ribao (Liberation Daily)*, Aug. 19, 1980; JPRS, No. 76,825; Nov. 17, 1980.
[63] Xinhua, May 10, 1980; FBIS, May 13, 1980.
[64] BR, No. 3, Jan. 17, 1983.
[65] GMRB, July 10, 1980; JPRS, No. 76,237, Aug. 15, 1980.

Faculty

The expansion in enrollment and the up-grading of curriculum require the availability of appropriately trained faculty, and here, China must cope with yet another serious handicap. Actually, considering that there are only a million and some students in the institutions of higher education, the reported number of nearly a quarter of a million is most impressive, until we consider the composition of this number; 4,200 professors, 19,700 associate professors, 118,300 lecturers, 46,300 "teachers" (clearly below the lecturer level), and 61,400 faculty assistants.[66] Professors and associate professors constitute only 9.6 percent of the total faculty; once again, the blame must be assigned to the Cultural Revolution, which devastated the ranks of the existing faculty and, for 10 years impeded the training of individuals who qualified for teaching positions at the college level. The result is that the knowledge of the older faculty members who survived the Cultural Revolution—many of them trained in the West or in the Soviet Union in the 1950s—is obviously dated, while the professional competence of the junior staff is extremely low.[67] As one author points out, too many new graduates "who are not qualified for teaching are pushed onto the teaching platform." [68] This problem is especially acute in fields of science and technology, where top level scientists and engineers are also in demand by research institutes of academies and production ministries.

Disregarding the quality and professional level of the faculty, much attention has been given to the underutilization of teachers by pointing to the unrealistic student-teacher ratio in China as a means of doubling college enrollment without unduly stretching the limited financial resources. For example, one 1980 article points out that whereas in other countries the teacher-student ratio is likely to be 1:10–22, in China it is extremely low: 1:1.35 if faculty and staff are combined and 1:4.31 if just faculty is considered.[69] The academic work load does tend to be very light in China, especially in key universities, but this does not justify the above comparisons. If the ratio given for universities in the West would include instructors and graduate students—as is the case in China—there would be a close parallel in the teacher-student ratios. Besides, we are also informed that "large numbers of teachers have not taught courses in many years."

It should be stressed, however, that because there is so much unevenness in the Chinese educational system, the situation with regard to faculty is not universally bleak—only bleak for most colleges. The reason is that key universities "swell with teachers to the point of suffocation," ordinary universities "hungrily hunt for them," and newly built universities "don't know where to find them." [70] One of the most revealing examples of the differences in the qualifications of teachers and in the disparity in the teacher-student ratios may be seen

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[66] *Liaowang (Observation Post)*, No. 5, May 20, 1982; JPRS, No. 81,811, Aug. 21, 1982. It should be noted that more rounded but identical faculty figures were reported a year later in 1983 (BR, No. 6, Feb. 7, 1983). Once again this is a reflection of the casual use of statistics rather than of stability in employment.

[67] For example, the average age of full professors in Beijing University was reported at 70. (BR, No. 4, Jan. 24, 1983).

[68] Xinhua, Nov. 12, 1980; FBIS, Nov. 14, 1980.

[69] GMRB, June 17, 1980; JPRS, No. 76,237, Aug. 15, 1980.

[70] Xinhua, Nov. 15, 1980; JPRS, No. 77,631, Mar. 20, 1981.

in the field of medical education. Based on information provided by the Ministry of Health, it can be calculated that medical colleges run by the Ministry have only 14 students for every professional associate professor, while in the rest of the medical colleges the ratio is about 105 to 1, with most of the instruction provided by lecturers and other teaching personnel.[71] The distribution of instruction personnel is also uneven between fields of specialization, with surpluses in some disciplines and shortages in others.

In addition to the obvious and long-term solution of filling teaching positions with new and most-qualified graduates (especially those with advanced training), the leadership is encouraging two other approaches, at least until the more permanent faculty can be engaged. If a direct transfer between the university with surplus staff and one with a shortage can not be accomplished, then it is recommended that the institutions share the faculty either through concurrent appointments or through loan or exchange. Pointing to the advantages of being a big fish in a little pond, Chinese style examples are given on how "a worm at Beida can become a dragon once it gets out," as in the case of an undistinguished lecturer who quickly made outstanding contributions when he transferred to the provinces.[72] Another suggestion for coping with the shortage of good teachers is to engage part-time teachers from scientific and research units, business enterprises, and even military services, stressing an additional bonus would be realized by this method since "it will not only help colleges, but will improve the professional standards of the scientific and technical personnel thus used." [73]

For every teaching position in Chinese institutions of higher education there are almost two people employed in administrative and other non-teaching jobs. The role of the 416,100 non-teaching personnel who were employed by the universities in 1980 is quite indicative of the whole character of higher education in China. The reason for the over-staffing was explained by the deputy directory of the Committee of Culture, Education, Science and Technology of the Central Committee of the Chinese Democratic League: [74]

> The university organization has to take care of everything, including even the teaching and administrative staff's routine affairs, childbirth, old-age, sickness, funerals, clothing, food, housing and transport. . . . The universities have to operate research institutes as well as nurseries and kindergartens, canteens for faculty and students, canteens and stores for dependents. In addition to building dormitories for the faculty and students, they have to build houses for the married faculty members, and even houses for foreign specialists. . . . Running a university becomes far more onerous and complicated than administering a county. So how can the university devote itself to teaching scientific research?

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[71] Leo A. Orleans, "China's Manpower for Medicine and Public Health," March 1982. Unpublished report prepared for the World Bank.

[72] CD, Feb. 19, 1983.

[73] *Ziran Bianzhengfa Tongxun* (*Journal of the Dialectics of Nature*), No. 3, June, 1980; JPRS, No. 77,745, Apr. 3, 1981.

[74] BR, No. 30, July 28, 1980. The distribution of the 416,400 "teaching and administrative staff" at institutes of higher learning is as follows: 55,200 auxiliary teaching staff (not included under full time faculty), 108,700 administrative personnel, 131,000 personnel doing "regular odd jobs," 16,800 scientific research personnel, 65,600 staff of school factories and farms, and 39,100 personnel in other subsidiary sections. (*Liaowang* [*Observation Post*], May 20, 1982; JPRS, No. 81,811, Sept. 21, 1982.)

Undoubtedly, the infusion of new graduates, especially with advanced degrees, into the faculty will eventually raise the level of instruction, but the process will be slow, at best, and limited for the most part to the key institutions. And there is yet another counteracting factor to be considered. As early as 1977 Deng Xiaoping expressed the need for key universities to become centers for scientific research—a departure from the past. As this plan to have research and teaching "straddle the system and straddle the faculty" is gradually being implemented, research activities rather than teaching will occupy more and more time of the higher level faculty. This will likely benefit the graduate student, but undergraduate education will continue to be relegated to the lecturer and the faculty assistants. Even now, some visiting Chinese professors show surprise when informed that American professors must teach regular classes.

Graduate Education

Surely everyone who has worked on China has had occasion to wonder whether contradictions with the reported data reflect Chinese confusion or the analyst's own limitations in understanding a particular statement or the entire system. Are our Chinese colleagues just as perplexed over some of the issues that are bothering us, or do they have all the answers and perhaps enjoy observing the "long noses" as we struggle to understand? This observation comes to mind at this juncture because while one might assume graduate education to be void of anomalies, it is in fact rife with them.

When did graduate education begin in China? In the 1950s and 1960s there was hardly a mention of graduate education in the country and, as a matter of fact, Beijing proudly announced that 1978 was the first year in which graduate students ever enrolled. In 1979, however, the Minister of Education reported that between 1949 and 1966 16,000 students completed graduate education in China [75]—a figure that was also reported by the New China News Agency and by Chinese officials in various briefings, as recently as November 1982. But there were other figures as well. In 1981 *Beijing Review* stated that "New China began enrolling postgraduates after its founding in 1949" (hardly a period when China was concerned about postgraduates) and that "by 1965 a total of over 23,000 postgraduates had been enrolled." [76] At the opposite extreme it was reported that in 1978 China enrolled some 10,500 postgraduates, which is "almost the total number trained the 17 years before the Cultural Revolution." [77] In other words, we may not know how many students received graduate education before the Cultural Revolution, but at least in retrospect we know that it existed. The most likely explanation is that while formal graduate degrees were not awarded in the 1950s and 1960s, there was what could be called a graduate apprentice system under which select students could pursue advanced study by working side by side with some of the more distinguished professors and academicians. But because of the informality of the system and an absence of standardized criteria, there is no way now for the authorities to estimate the number of young people who managed to get something comparable to a graduate education through work and association. But a difference

[75] Gao Yi, "Report to the 37th Session of the International Conference on Education," Geneva, July 1979.
[76] BR, No. 28, July 13, 1981.
[77] Xinhua, Jan. 10, 1979.

between 10,000 and 23,000 does seem a bit large, even if they are guesses.

So much for the earlier period. Surely data regarding current numbers in graduate education will be straightforward, devoid of mystery. Not so. In 1982 a Chinese Education Association for International Exchanges publication included these puzzling statistics. Page 2 of the text states that in 1980 the universities admitted 3,616 graduate students and that the total graduate enrollment was 21,604; in the appendix of the same publication the figures (also for 1980) were 2,964 and 17,728 respectively.[78] Is there something we haven't been told? We can speculate that the lower figures refer only to the students in the institutions of higher education and the higher figures also include graduate students in the institutes of the science academies, but it was independently reported that in 1980 only 1,345 graduate students were admitted by the CAS.[79] Besides, why should we have to guess?

For 1982 the number of entrants into graduate education was variously reported at 11,000,[80] 11,792,[81] and 14,000.[82] In 1981, for the first group completing graduate education since the Cultural Revolution, we have the option of selecting either 2,073 [83] or 11,000.[84] One figure seems too low, the other too high, but despite the tremendous range, a case can be made for both. In 1978 (the first year of graduate education) universities and institutes enrolled 10,500 students [85] for studies that were to last 2–3 years, but could be extended to 4 years for those who were also working. We can argue that the first group was inadequately prepared for graduate work and that after 3 years only 2,073 students were given degrees. Or we can assume that after 3 years most of the 1978 entrants and some of the 8,500 1979 entrants [86] managed to complete their studies, for a total graduating class of 11,000. As for the number of graduate students completing their studies in 1982, so far we have only one figure, 6,200.[87]

The most complete statistics on graduate education are for the number of students annually admitted into this program. Based on this information, one could assume the following series of rounded figures to be reasonable: 1978—10,500, 1979—8,500, 1980—3,600, 1981—10,000, and 1982—11,500. These numbers are basically confirmed by the statement that 32,000 postgraduate students were enrolled in the first 4 years,[88] only 600 lower than the sum derived from the above figures. The low figure for 1980, by the way, reflects the limitation in facilities and staff for graduate studies—some students had to graduate before the number of entrants could increase again. It

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[78] The Chinese Education Association for International Exchanges, "Recent Development of Education in the People's Republic of China (1979–1980)," April 1982.
[79] Xinhua, July 9, 1982.
[80] Xinhua, Jan. 9, 1982; JPRS, No. 79,954, Jan. 27, 1982; also in a speech by Deputy Minister of Education (RMRB, Nov. 18, 1982; FBIS, Nov. 23, 1982).
[81] GMRB, May 8, 1982; JPRS, No. 81,830, June 28, 1982.
[82] Xinhua, Oct. 31, 1982; FBIS, Nov. 4, 1982.
[83] *Zhongguo Xinwen (China News)*, Jan. 30, 1981; JPRS, No. 77,826, Apr. 14, 1981.
[84] Xinhua, Sept. 28, 1981; FBIS, Oct. 1, 1981.
[85] Xinhua, Jan. 10, 1979; FBIS, Jan. 11, 1979.
[86] Xinhua, Oct. 24, 1979; FBIS, Oct. 24, 1979. The distribution of this total is as follows: 7,200 at universities, 350 at CAS, 150 at CASS, and 600 at other institutions, which, incidentally, falls 200 short of the total.
[87] Xinhua, June 15, 1982; FBIS, June 16, 1982.
[88] Xinhua, Aug. 25, 1982; FBIS, Aug. 27, 1982. Although the date on this dispatch would suggest that the total refers to the full 5 years (1978–82), it clearly refers to just 4 years.

should also be noted that of the 19,000 graduate students enrolled in 1978 and 1979, "the vast majority" completed college in the 1961–65 period and were "around 35 years old." [89] The average age of the new entrants into graduate education is now down to the mid or late 20s.

For 1983, China projects that 15,000 students will be admitted "for master's degrees and preparation for study abroad." [90] If Shandong Province is characteristic of China, then about 10 percent of the total are preparing to study abroad, leaving 13,500 new entrants for graduate education. This is a 2,000 increase over 1982 and seems quite consistent with the recent trend. (For additional statistics on graduate education see Appendix B.)

When we depart from statistics, the story of graduate education becomes somewhat more intelligible. The proposal to give formal graduate degrees was approved by the State Council's Academic Degrees Committee only in 1980—2 years after the first graduate students were admitted. Most are enrolled in institutions of higher education, but between 5 and 10 percent of the most promising students pursue their graduate studies in research institutes of the Chinese academies of sciences, social sciences, medicine, and agriculture, which give their own examinations to applicants for graduate studies. Since some institute scientists also teach at the universities, they are in a position to spot the best students and to make sure they apply (and get accepted) to the institute for advanced training. In August 1981 it was reported that 300 institutions of higher education and more than 300 scientific research organs had enrolled postgraduate students. The uneven quality of these organizations obviously created some concern within the academic community: a call went out to "scrutinize the awarding units" and make sure that they "uphold the standards, make strict demands, safeguard quality, and be fair and reasonable." [91] To comply with these guidelines, the Academic Degrees Committee set out new standards. Institutions had to meet some minimal qualifications for the level of faculty, research facilities and, of course, students, before being granted authority to confer graduate degrees. Somewhat surprisingly, about a year later, the number of institutions of higher education approved to award advanced degrees increased to 324, and the number of scientific research institutes decreased to 133.[92]

There is also an ongoing effort to raise the qualifications of graduate students. The basic selection process still requires the candidate to be of good moral character, healthy, under 35 years of age and capable of passing a series of special examinations which include political theory, a foreign language and a test of some of the basics in their specialty. New regulations also state that enrollment units must carefully review even the students who pass the examinations and disqualify any who fall short in terms of their personal characteristics.[93] An additional 3-hour examination was added for some of the majors, and university students cannot be accepted into graduate studies prior to the completion and review of their senior theses or projects.

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[89] *Xuexi Yu Tansuo (Study and Exploration)*, No. 4, 1980, Heilongjiang Radio, July 15, 1980; FBIS, July 17, 1980.
[90] *Dazhong Ribao (Masses Daily)*, Dec. 4, 1982; JPRS, No. 82,991, Mar. 2, 1983.
[91] GMRB, Aug. 3, 1981; JPRS, No. 79,140, Oct. 5, 1981.
[92] GMRB, May 8, 1982; JPRS, No. 81,380, July 28, 1982.
[93] Xinhua, Oct. 31, 1982; JPRS, No. 82,347, Nov. 30, 1982.

In 1982 the Academic Degrees Committee of the State Council announced that China's first doctoral candidates had been accepted by 54 universities and 15 research institutions. The distribution of the 420 new candidates who will study from 2 to 3 years is as follows: 191 will major in science, 137 in engineering, 60 in medicine, 16 in literature, 11 in history, 2 in philosophy, 2 in pedagogy, and 1 in agronomy.[94]

China's determination to up-grade the level of graduate education is also evident in the rather basic structural changes that are being made in the training of advanced scholars. In the past there was a sharp separation between education and research, with virtually all the research (especially in science and technology) being done in the institutes of the academies and the ministries. The leadership is now convinced that in order to improve both education and research, this system, inherited from the Soviet Union, must be changed. This is obviously a slow process and one which must overcome handicaps stemming from the lack of research personnel with research experience in the universities, inadequacy of laboratories and equipment, shortage of funds, and inertia. Nevertheless, progress is being made. More and more academicians now have part-time teaching positions in the universities, and more and more professors hold advisory or administrative positions in the institutes of the academies. Furthermore, in the last few years, the institutions of higher education have been able to implement their meager research budget by doing contractual research, especially for industrial enterprises. The importance of industrial contracts is evident from the statement by one official that in the large technical universities there is a 2:1 ratio between research funds from industrial contracts and those from the Ministry of Education—a proportion that is likely to increase in the coming years. Most important, from the standpoint of quality, these research activities which bring with them improved facilities and equipment, provide research and study opportunities for graduate students which did not exist in the past.

Finally in the last 10 years, and especially more recently, Chinese institutions of higher education and academy institutes have been taking advantages of a continuous flow of foreign scholars who have been coming to China to lecture and conduct scientific research. This exposure to some of the world's leading specialists in a great variety of fields should be especially valuable to the country's graduate students.

Foreign Training

That science will lead the way to China's modernization is a conviction expressed in the past by the Kuomintang government, just as it is held today by China's current leadership; and to study modern science, students must leave the country. Both before and after 1949, political shifts and changes in perceptions caused fluctuations in the number of students selected for training overseas. Nevertheless, when the climate was right, thousands of young Chinese students went abroad under the auspices of the government, with the help of foreign

[94] Xinhua, Aug. 14, 1982; FBIS, Aug. 16, 1982. Less than a year later, the first Ph D degrees were awarded to 18 students in Beijing. (CD, May 29, 1983).

institutions, or through the private financing of their families. Many of them never returned to China, but those who did formed the core in science and technology and quickly rose to prestigious positions in the government or the professions. From the turn of the century till now, China's scientific elite has been almost exclusively foreign educated.

During the decade of the 1950's, China probably added more foreign-trained scientists and engineers than in any other 10-year period. After 1949, Beijing made a special appeal to the patriotism of Chinese scientists and scholars living in foreign lands, and by 1957, 2,500 had returned to play a very important role in the development of the nation.[95] But most of the increase in the numbers of foreign-trained students and scholars was, of course, accomplished with the assistance of Socialist countries—primarily the Soviet Union. Between 1949 and 1960, of the 17,705 Chinese students who studied in these countries, 11,000 were in the Soviet Union.[96] During this period the Soviet Union also admitted for training 1,200 faculty members from Chinese institutions of higher education, 1,300 scientists, mostly from the CAS, and 8,000 technical workers.[97] If the student ratio between the Soviet Union and the other East European countries was constant, there were approximately 40,000 Chinese trained by the Warsaw Pact countries in that decade—and the overwhelming proportion of them were in science and technology. It is generally assumed, however, that because of the narrow Soviet training, most of the Chinese returned to work in production enterprises and not in research institutes.

There were also many thousands of Soviet teachers, advisers and specialists who did their training within China. It was reported that 1,269 Soviets worked in the Ministry of Education or taught in Chinese universities, and thousands of other Soviet specialists—on short- or long-term assignments—assisted and instructed on various technical and scientific projects.[98]

After the 1961 rift between Beijing and Moscow, the scientific and cultural relations between the two countries also ceased. Burnt by the Soviet Union (a debatable Chinese assertion) and unable to find a sympathetic ear in the United States, China turned inward, vociferously attacking all foreign contacts and stressing the need for self-sufficiency and self-reliance.

Some student exchanges with the outside world resumed by the mid-1970's, but they did not reach significant proportions until 1978—2 years after the death of Mao. Surprisingly, even statistics on the number of Chinese students studying abroad are still not precise, whether obtained from the Chinese side or from the country accepting them.

In this instance, let us reverse the process and start with the American perspective and estimates on Chinese students. Based on visa issuances by the United States, there are over 9,000 Chinese students and visiting scholars now studying in this country. Approximately half of

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[95] *Zhongguo Dalu Yanjiu (Mainland China Studies)*, No. 33, 1972, as quoted in A. A. Antipovskiy, et al., *Politika v Oblasti Nauki i Obrazovaniya v KNR (Politics in the Field of Science and Education in the PRC)*, Moscow, 1980, p. 196.

[96] Ibid., p. 200.

[97] Ibid., p. 119.

[98] Year-by-year statistics on Soviet specialists working in China between 1949 and 1960 were presented in O. B. Borisov and B. T. Kolosov, *Sovetsko-Kitayskiye Otnosheniya (Sino-Soviet Relations)*, Moscow, 1980, p. 177.

them are sponsored by the Chinese Government and the rest through private funding, mostly by family members in the United States. Of the government-sponsored students and scholars, about 65 percent are in engineering and natural sciences, 25 percent are in some type of management study, and the remaining 10 percent major in miscellaneous subjects. Most of the students in the official exchange category stay 2 years in the United States and attend some of the country's most prestigious universities. In the first couple of years of the exchanges most Chinese who came to the country were in their forties, but now an ever greater proportion of the students comes from the ranks of recent college graduates, significantly lowering their average age. Students who are in the United States under private sponsorship are, for the most part, attending a straight 4-year undergraduate curriculum with a much smaller percentage in engineering and the sciences. Since no single agency or organization keeps track of them, there is very little information on the characteristics of the privately sponsored Chinese students.[99]

If the current estimate is correct, that approximately half of the Chinese students abroad are in the United States, then there must be about 9,000 studying in other countries. About half of them are thought to be in Japan, where more are assigned to individual industrial enterprises (to learn and gain experience) than to universities, and a little less than half are distributed among the United Kingdom, Germany and France. Whatever the residual might be (probably not more than 5 percent), it includes students in perhaps 50 other countries around the world.

The Chinese, on the other hand, reported that in 1978 and 1979 they sent a total of 2,700 students to 41 countries. Over 2,100 were selected by educational departments and 600 by the Chinese Academy of Sciences.[100] There is certainly no reason to quarrel with these figures, which obviously refer only to the officially sponsored students. In 1982, however, it was reported that "some 12,000 persons have been sent to study at the schools in 54 countries," with the largest number to be found in the United States.[101] This figure seems too high to include only government-sponsored students and too low to include all types of students studying abroad. At least it seems that way on the basis of the American estimates referred to above. Unfortunately no one has ever assembled relevant statistics from all the countries which are hosting Chinese students. Chinese Embassies apparently keep records only on official students who receive monthly stipends and unofficial students who choose to inform the Embassy of their presence in the country.

Finally, the following figures are presented, not to further confuse the reader—although they surely will—but because they represent the first such compilation in what appears to be one of the more official

[99] For more detailed discussions of academic exchanges and characteristics of Chinese students in the United States, the reader is referred to: Ralph N. Clough, "A Review of the U.S.-China Exchange Program," Feb. 23, 1981. Report prepared for the Office of Science and Technology (White House) and the Office of Research (USAID); and Thomas Fingar and Linda A. Reed, *An Introduction to Education in the People's Republic of China and U.S.-China Educational Exchanges*, U.S.-China Educational Clearinghouse, Washington, D.C., January 1982.

[100] Xinhua, Dec. 22, 1979; FBIS, Jan. 7, 1980.

[101] Xinhua, Aug. 22, 1982; FBIS, Aug. 23, 1982.

of official sources.[102] This 1982 publication of Beijing's Education Science Press, cites the following numbers of students going and returning from abroad:

Years:	*Sent abroad*	Years:	*Returned from abroad*
1950–65	10,698	1953–65	8,213
1972–76	997	1974–75	445
1977–80	4,981	1977–80	830
Total	16,676	Total	9,488

By virtue of the nature of the source and the precision of the figures, it is tempting to accept them as "the final word." But there are the inevitable questions. Some definitions and finer breakdowns would help. Does "sent abroad" include those who "went abroad"? The figures imply that some students were sent in 1950 but that none returned before 1953. Is that reasonable? It would be more useful to have figures on students sent abroad between 1950–60 and 1960–65, because it is difficult to imagine that China had more than a handful of students studying abroad in the 1962–65 period. How do the 10,698 students sent abroad between 1950 and 1965 relate to the Soviet report that 17,705 Chinese students studied in the Socialist countries between 1949 and 1960? The fact that of 4,981 students sent abroad between 1977–80 only 830 have returned is quite clear—most had not yet completed their education. But what about the earlier years? Does the difference between those sent and those returned represent a "brain drain" of sorts, or did they eventually straggle back to China? And finally, it is unlikely that the Chinese themselves would be able to rationalize these figures with their own earlier statistics.

Obviously, the best possible candidates are selected for study abroad. At a 1980 conference on the subject it was stressed that foreign training is not a temporary phenomenon just for the period when there is a shortage of high-level manpower, but will be an ongoing process. It was also pointed out that "In selecting people to study abroad, priority should be given to the natural sciences, while some people are also sent to study the social sciences and foreign languages; and in the field of natural sciences, priority should be given to technological sciences, but without ignoring the needs for basic sciences and applied technology."[103] This, in fact, has been the pattern over the past years.

A small number of universities and research units have been designated to run preparatory courses for students applying for overseas education. Their tests will closely resemble those given to all applicants for graduate education except that "higher scores are demanded for foreign language tests."[104] Some young people slated to study in Japan attended a special preparatory school which was established in Changchun (in conjunction with the Jilin Normal College) and hired Japanese teachers for language training and to lecture on other topics.[105]

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[102] *Zhungguo Gaodeng Xuexiao Jianjie (Brief Introduction to China's Institutes of Higher Education)*, Education Science Press, Beijing, 1982.
[103] Beijing Radio, Jan. 4, 1980; FBIS, Jan. 9, 1980.
[104] Beijing Radio, June 15, 1981; FBIS, June 22, 1981.
[105] Xinhua, Mar. 21, 1979; FBIS, Mar. 24, 1979.

One interesting aspect of sending students abroad is that China's youth perceives their success to be tied to the English language—a notion which is based on considerable evidence—and almost invariably chooses the United States for study. Chinese administrators of overseas education must apply considerable pressure to propel them into other languages and countries.

Sending youth abroad is a risky enterprise for China, and the expansion of the student exchanges has not been without anguish for the leadership. At the very start of the exchanges with the United States, Deng Xiaoping conceded that while China would probably lose some students who would opt to stay abroad, it was nevertheless a risk that must be taken. Indeed, a considerable number of students, especially among those who are financed by relatives and friends, are remaining overseas. To control this exodus, Beijing is making it more difficult for privately sponsored students to obtain visas and even top-level cadres now require the best possible "back door" connections to send their offspring abroad for study.

The changes in China's urban society are often blamed on domestic and foreign contacts with nationals of other countries, causing some strong reactions in the Chinese media and inspiring periodic anti-foreign spurts (no longer major campaigns). The decline in the social morality of youth is often blamed on the exposure to Western bourgeois ideas. In one article, Beijing's *Weekly Digest* singled out scientific exchanges as a primary culprit in spreading "the rotten spirit of capitalism" within the Chinese Communist system, and in causing an "extremely complicated situation." The weekly said that academic and scientific exchanges were being used by "the enemies of our country" to infiltrate the various institutions, particularly using "the children of leading cadres to cultivate their forces in China.[106] Occasional outbursts notwithstanding, China's top leadership understands the fundamental linkage: science and technology are an imperative of modernization and modernization is inherently destabilizing. Unfortunate as the side effects may be, China's need for scientific and technical contacts is so great that it would take another major political shakeup to disturb the basic exchange arrangements or to restrict contacts with foreign specialists. Nevertheless, some will continue to insist that "the insidious peaceful evolution" foisted on China by "hostile foreign elements" will continue to "spread ideological poison" and "contaminate the social practices of the country."[107]

No clear answer is immediately evident to one of the more obvious and important questions: How do the Chinese intend to utilize the students and scholars who are being trained abroad? The Chinese are not telling us, but perhaps they have nothing yet to tell, since only recently has there been a real need for clear-cut policy. The earlier exchange contingents were older and probably returned to the units which sent them or from which they were selected. Now, however, the young college graduates who are going abroad to study have not yet been assigned to a production or research unit. While this undoubtedly increases flexibility in assignment, it may also require

[106] As reported by Charles-Antoine de Nerciat. Hong Kong AFP, June 24, 1982; FBIS, June 24, 1982.
[107] *Shaanxi Ribao (Shaanxi Daily)*, July 7, 1982; JPRS, No. 81,777, Sept. 15, 1982.

more precise guidelines. In the meantime, we know that China has high expectations for these individuals—so high, in fact, that many of the students are extremely nervous about their ability to compensate the state for its investment and to fill the giant shoes that are awaiting them.

Writing about young Chinese with foreign degrees acquired during the Republican period, Charlotte Furth said, "It made them more aware of the complexity of the West itself and of the full implications of China's material backwardness, more critical of the Chinese past, and, thus, torn between angry iconoclasm and nostalgic attachment to a great cultural heritage," making them "a relatively alienated group, concentrated in a few universities, government bureaus, and commercial seaports." [108] Of course, China today cannot be compared to China 50 or 60 years ago, but this quotation creates a useful backdrop for some questions which cannot yet be answered. How will the new returnees be accepted by their colleagues who did not have the opportunity for foreign training? Despite the national emphasis on youth, how will the younger professionals fit into organizations where older individuals with less education are directing the work? Will the people returning from abroad be satisfied with China's facilities and equipment? [109] How well will they adjust to prescribed research and restrictions on initiative? So far the number of returned students is still too small (about 2,000 from the United States) to make any generalizations on these questions, but there is no doubt that the Chinese themselves are watching with more than a little interest as the answers develop.

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[108] Charlotte Furth, *Ting Wen-chiang. Science and China's New Culture*, Harvard University Press, Cambridge, Mass., 1970, p. 3.

[109] In his speech at the Planning Conference of CAS, Lu Jiaxi, the Academy's president, referred to this problem. Students returning from West Germany told him that while they were away they did research in the most advanced areas of science, but because there was no comparable equipment, they had to go back to the work they did before studying abroad. "Such studies abroad thus lose their meaning," said Lu. (*Keyan Guanli (Management of Scientific Research)*, No. 3, July 1982; JPRS, No. 83,240, Apr. 12, 1983.)

THE PROFESSIONAL MANPOWER POOL

College Graduates: How Many and How Good?

In the last section we considered the statistics on college entrants, graduates, and enrollment; now let us return to the statistical quagmire and consider the size of the manpower pool with completed higher education. Table 4 presents a rather fascinating and revealing collage of statistics on the subject. How can we explain the anomalies and what conclusions can we draw?

Let's deal first with the two high figures (columns 7 and 8). The 5.2 million graduates reported by Xu Dixin, the President of China Population Science Society, seems so far out of line that one might assume a typographical error, if it were not for a still higher figure (not included in the table). In an article entitled "How to Interpret the Census Communique," the author states that "of every 100,000 people in China, 599 have received university education."[110] Applying this ratio to the census population, it becomes obvious that the resulting figure includes not only people with completed higher education, but also 1,602,474 individuals "who studied previously but did not finish and those now attending university," for a combined total of 6,016,969. Obviously Xu also included some portion of these individuals in his total of 5.2 million.

As for the census itself, the 4,414,495 (sic!) college graduates figure is also too high, but in this instance there are some explanations. First, the census includes individuals who completed their higher education (in China or abroad) prior to 1949, but since the number of these survivors probably does not exceed 50,000 we must look further. The census procedure was for the forms to be completed by either the individual or the head of household and then submit them to the census registration stations. It would have been difficult and time-consuming for the census officials to check this particular entry and obviously many people made their own interpretation of educational achievement, perhaps assuming college-level comparability through work experience and/or job title. This is especially likely since the occupational titles that would normally imply a college education can be obtained through practical experience. In the medical and public health system, for example, after 5, 10, or 15 years of diligent and practical application, nurses, pharmacists, and other medical personnel can qualify either directly or through an accelerated curriculum to become at least a "middle doctor" (yi-shi) and sometimes even a full doctor (yi-sheng). According to one estimate, upward mobility has produced 10 times as many medical practitioners as the conventional medical schools.[111] The medical field, however, is not alone in

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[110] BR, No. 48, Nov. 29, 1982, p. 13. Incidentally, the article also confuses the reader by stating flatly that on July 1, 1982 China had a population of 1,031,882,511—neglecting to point out that this total includes Taiwan.

[111] T. O. Cheng, L. Axelrod and A. Leaf, "Medical Education and Practice in the People's Republic of China," *Annals of Internal Medicine*, Vol. 83, No. 5, Nov. 1975.

TABLE 4.—ALTERNATE DATA ON NUMBERS OF GRADUATES FROM INSTITUTIONS OF HIGHER EDUCATION, 1949–82*

	1	2	3	4	5		6		7	8
1949	21,000	21,000								
1950	18,000	39,000								
1951	19,000	58,000								
1952	32,000	90,000								
1953	48,000	138,000								
1954	47,000	185,000								
1955	55,000	240,000								
1956	63,000	303,000								
1957	56,000	359,000								
1958	72,000	431,000								
1959	70,000	501,000								
1960	135,000	636,000								
1961	162,000	798,000								
1962	178,000	976,000								
1963	200,000	1,176,000								
1964	200,000	1,376,000								
1965	170,000	1,546,000								
1966										
1967										
1968										
1969										
1970										
1971										
1972										
1973	29,000	(1,575,000)								
1974	(165,000)	(1,740,000)								
1975–76	(150,000)	(1,890,000)								
1977	(117,000)	(2,007,000)								
1978	166,000	(2,173,000)								
1979	162,000	(2,335,000)								
1980	146,000	(2,481,600)								
1981	139,000	(2,621,200)								
1982	311,000	(2,932,200)								
Total	(2,932,200)	(2,932,200)	3,540,000 (1949–1982)	2,946,000 (1949–1979)	1,554,000 (1949–1965)	3,178,000 (1949–1980)	2,024,000 (1949–1967)	3,274,000 (1949–1980)	4,414,495 (as of July 1, 1982)	5,200,000 (1949–1980)
					1,033,000 (1966–1976)		1,250,000 (1968–1980)			
					591,000 (1977–1980)					
				146,600						
				139,600		139,600		139,600		139,600
				311,000		311,000		311,000		311,000
Total	(2,932,200)	(2,932,200)	3,540,000	3,543,200		3,628,600		3,724,600	4,414,495	5,650,600

*Figures in parenthesis are estimates or include estimates.

Sources:

Column 1. For 1949–76, 1978, and 1979, see L.A. Orleans, *Manpower for Science and Engineering*, Committee on Science and Technology, U.S. House of Representatives, Washington, 1980, p. 18. For 1977 and 1980–82, see Table 1. All figures were officially reported except those in parenthesis.

Column 2. Cumulative totals.

Column 3. *Beijing Review*, No. 6, Feb. 7, 1983, p. 21. The source also states that 600,000 of this total graduated in the last four years (1979–82). In fact, independently reported figures add to 759,200 (see column 1).

Column 4. GMRB, June 4, 1980; JPRS No. 76,175, Aug. 7, 1980.

Column 5. Ministry of Education, *Education in China*, Beijing, 1981, p. 28.

Column 6. GMRB, Jan. 10, 1982; JPRS No. 80,227, March 3, 1982.

Column 7. This figure from the 1982 census was reported by Xinhua, Oct. 27, 1982, FBIS, Oct. 27, 1982. Because it is a census figure, it includes individuals who completed higher education prior to 1949. Their number, however, is not likely to exceed 100,000. The census dispatch also states that the reported total does not include 1,602,474 individuals "who studied previously but did not finish and those now attending universities."

Column 8. *Jingji Yanjiu (Economic Research)*, No. 4, April 20, 1981; FBIS May 27, 1981. From a speech by Xu Dixin, Vice President of the Chinese Academy of Social Sciences and President of the China Population Science Society. By stating that the 5.2 million represents 0.5 percent of China's population, he implies a total population of 1,040,000,000, or some 50 million higher than the reported figure for end-of-year 1980.

this practice. An article in the *People's Daily* reported that outstanding graduates of secondary professional schools have become "chief and deputy chief engineer, factory and mine directors, principal physicians and agronomists."[112] As might be expected, the specific criteria for successful upward mobility are determined locally and therefore vary throughout China. But these individuals too are included in the 4,414,495 total.

[112] RMBR, Apr. 29, 1980; JPRS, No. 75,732, May 20, 1980.

So much for columns 7 and 8. The totals in columns 3 through 6 of table 4 are within a reasonable range of 3,540,000 to 3,725,000—for a difference of "only" 185,000. A more serious difference, however, is apparent when these totals are compared with the summation of the year-by-year figures published over the past 3 decades (column 1). A few years ago it would have been impossible to pinpoint this discrepancy of approximately 800,000, but the Ministry of Education publication (column 5) reveals the source of the problem by breaking the graduates into three groups. There is a general consistency in the statistics on the 1949 through 1965 graduates and on those who finished college after 1976. The mystification arises in the middle period with the statement that between 1966 and 1976, 1,033,000 students graduated from institutions of higher education. Universities were closed in the late 1960's and started to reopen very gradually after the Cultural Revolution. In 1970 there were only 29,000 entrants into what passed as higher education at the time [113] and the total enrollment was only 48,000.[114] On the basis of available data on entrants and enrollment, the number of graduates between 1970 and 1976 could not possibly exceed 350,000.[115] Where did the other 700,000 or so graduates come from? Unless we are given information to the contrary, the only plausible explanation would seem to be that somewhere along the way most of the 674,000 students who were enrolled in higher education in 1965,[116] but whose education was interrupted by the Cultural Revolution, were decreed to have completed college. The rationale might well have been that even a year of college for this highly selective group would be more than comparable to the 2 or 3 years of modified, production-oriented curriculum, taken by ill-prepared entrants of the 1970's.

This leads to the question of quality of university graduates. It is probably safe to say that not another country has as wide a range of competence among its college graduates as does China—an aspect of both ability and education. The variations, already discussed, stem from the types of schools and number of years attended, and from the period during which a young person was in college. Graduates of some of the 2-year colleges cannot be compared to a 4-year graduate from a comprehensive university in Beijing; and a person who entered college in 1971 or 1972 is a far cry from one who entered in 1963 or 1983. Obviously there are too many variables and not enough data to attempt even a most tenuous qualitative distribution of China's college graduates and the only consolation is that the Chinese themselevs are not able to devise such a measure at the national level.

In practice, of course, the difference between the various schools and graduating classes are recognized by all. No one can argue with the statement that "In the history of education in New China, the years 1961–65 were the most brilliant" in terms of both the thorough screening of applicants and the education received by those who were selected.[117] And at the other extreme are the "peasant, worker, soldier" students who attended the so-called colleges between the Cultural

[113] JMRB, Dec. 30, 1973.
[114] *China Reconstructs*, Sept. 1982, p. 12.
[115] Leo A. Orleans, *Manpower for Science and Engineering in China*, Committee on Science and Technology, U.S. House of Representatives, June 1980, p. 18.
[116] Ministry of Education, *Education in China*, Beijing, 1981, p. 28.
[117] *Xuexi Yu Tansuo (Study and Exploration)*, No. 4, 1980; FBIS, July 17, 1980.

Revolution and 1977. In 1981, for example, 4,546 students graduated from the 7 National Defense Industrial Colleges. Perhaps they are not typical, but nevertheless, only 16.6 percent were graduates of senior middle schools when they were admitted in 1977 and the rest were "workers, peasants, soldiers, or unemployed school graduates." [118] Jiang Nanxiang, who was Minister of Education in 1980, charged that the policies of the "gang of four" not only ruined the masses of young people, but also greatly harmed the country and many generations to come." [119] This is not much of an exaggeration and the regime is struggling with many problems associated with the post-Cultural Revolution graduates. Whether they represent 900,000 people as now claimed, or a much smaller figure as suggested by earlier statistics, the authorities are attempting to improve the qualifications of these workers—many of whom are employed in various technical and even scientific positions—and to change the attitudes toward them that have developed over the years.

Quite understandably, many of the leading cadres—and especially the managers—are said to have a "one-sided view" of the college cohorts of the Cultural Revolution, are unwilling to accept them, and regard them as "good-for-nothings and pay no attention to them." [120] The leadership, however, believes that there are too many in this group to be ignored, especially since they cannot be blamed for "being born at the wrong time." Soon after the death of Mao, Hua Guofeng pointed out that "they should be given all the care and assistance they need to grow and mature," and since then many officials have expressed the need to establish a "correct attitude" toward this work force with "paper college degrees."

The main effort is on re-education, but while some Cultural Revolution graduates are indeed capable of improving their qualifications, a very large proportion of them are not. The impression one gets is that within the drive for continuing education, these particular individuals receive special attention so that they may move up to the best of their ability. Beijing is, of course, the leader in this effort and both in 1980 and 1981 the city held a series of examinations for "people who went through college during the Cultural Revolution when China's institutions of higher learning were in a sorry shape." The purpose of these tests was to encourage deficient workers to raise their knowledge "to the levels of pre-1966 college graduates" by pinpointing their weaknesses and deficiencies. But after a four-month course, in which units invited teachers from the major universities to serve as tutors, "68.9 percent of the students failed the higher mathematics portion, 73 percent flunked physics, and 56 percent failed the chemistry portion." Those who failed, however, could continue their studies and re-take the examinations.[121]

Another example comes from Yunnan. Here it was reported that over half of the Yunnan Provincial Scientific and Technical Information Center's staff consists of graduates of the 1966–76 period. Since 1978 these staff members have been offered a variety of courses and lec-

[118] *Gao Zhao Zhanxian (Higher Education Front)*, No. 3, March 1982; JPRS, No. 82,070, Oct. 25, 1982.
[119] Xinhua, Apr. 12, 1980; FBIS, Apr. 18, 1980.
[120] *Yunnan Ribao (Yunnan Daily)*, May 30, 1982; JPRS, No. 81,432, Aug. 3, 1982.
[121] Xinhua, Dec. 28, 1980; JPRS, No. 77,202, Jan. 19, 1981.

tures (on official time) and many of them have been able to move up within the organization. Some were even sent to universities to pursue advance studies.[122]

These activities may further complicate any effort to evaluate the levels of college graduates in China, but from the perspective of managers who are struggling with inadequate personnel, whatever results are achieved can be of direct benefit to the units where they work.

Number of Scientific and Technical Personnel: Evidence and Speculation

It is reasonable to expect that the current employment statistics on scientific and technical personnel would be less suspect than the total number of graduates, collected over a period of 30 tumultuous years. There is inded more consistency in these figures; nevertheless, because of interpretation and definition difficulties, we end up with something more than numbers but less than statistics. In fact, what follows is a maze which some readers who are not statistically oriented may wish to skip.

In recent years China has been publishing figures on the total size of each scientific and technical contingent employed in "units under the ownership of the whole people"—a basic category which includes more than three-quarters of the urban labor force. This category includes workers and employees who receive wages or salaries from state-run enterprises, institutions, and units, including state farms in the rural areas. It excludes individuals in units under communal or collective ownership, in privately owned retail or service activities, side-line occupations in rural areas, and so forth. The number of scientific and technical personnel in state-owned units has been growing fairly rapidly: 1978—4,345,000, 1979—4,705,000, 1980—5,296,000, 1981—5,714,000, and 1982—6,264,000 [123]. And during the same five years their proportion of the total number of wage and salary earners has increased from 5.8 to 7.3 percent. But what proportion of the total number of scientific and technical personnel do those in state units represent? We have a useful clue. One report stated that in 1979, of the 5,544,000 scientific and technical personnel, 4,705,000 worked in state-owned units, or 85 percent of the total.[124] Since this is a reasonable proportion and one not likely to change significantly over the years, we can assume the total number of scientific and technical personnel in China was approximately 6.2 million in 1980, 6.7 million in 1981, and 7.4 million in 1982.

Table 5 presents the most detailed information on the employment of scientific and technical personnel in the state sector, which is the focus of our discussion. Unfortunately, although the same data appear in several Chinese sources, they are never accompanied by definitions of the categories or interpretations of the statistics, which may be clear to the Chinese, but leave some of us who lack the insights of a native,

[122] *Yunnan Ribao*, op. cit.

[123] 1978 and 1979 from State Statistical Bureau, *Main Indicators*, Beijing, 1980, p. 9; 1980 and 1981 from State Statistical Bureau, *Statistical Yearbook of China 1981* (English Edition), Hong Kong, 1982, p. 462; 1982 from B.R., No. 19, May 9, 1983, p. X.

[124] Hu Ping, "Education and Development of S&T Personnel," paper presented at the Joint NAS–CAS Science Policy Conference, Washington, D.C., Jan. 9–12, 1983.

TABLE 5.—SCIENTIFIC AND TECHNOLOGICAL PERSONNEL IN STATE ORGANS AND ENTERPRISES, 1981

[In thousands, educational background]

Departments	Total	Engineering and technical	Agrotechnical	Health	Scientific research	Teaching
Total	5,714	2,077	328	1,680	338	1,291
1. Industry and construction	1,596	1,229	4	268	15	80
2. Prospecting and designing	237	221	1	10	3	2
3. Agriculture, forestry, water resources and meteorology	462	168	231	41	5	17
4. Transport, post and telecommunications	174	152	.....	19	.....	3
5. Commerce, foods, services, and materials supply and marketing	47	25	10	11	1	.....
6. Urban public utilities	25	19	1	4	1	.....
7. Scientific research	346	35	3	13	293	2
8. Culture, education, health and social welfare	2,534	45	2	1,286	16	1,185
9. Banking and insurance	3	3	.....	.....	.....	.....
10. Government departments and organizations	290	180	76	28	4	2
Female	1,815	346	46	965	94	364
Percent	31.8	16.7	14.0	57.4	27.8	28.2
Attended colleges or universities	2,495	1,037	115	432	251	660
Percent	43.7	49.9	35.1	25.7	74.3	51.1

Source: *Beijing Review*, No. 7, Feb. 14, 1983, p. 16.

with many unanswered questions. Nevertheless, these figures represent the best available take-off point for a discussion and perhaps some of the suggested interpretations and questions will stimulate others to correct the errors or to seek the answers.

Because the figures in Table 5 are not limited to college graduates, our first concern must be with the distribution of these personnel by level of education. As the table indicates, only 43.7 percent (2,495,000) of the total are "persons who received higher education" (a literal translation from the Chinese) or, probably more accurately, persons who "attended colleges or universities" (as rendered into English by *Beijing Review*). As might be expected, the highest proportion of people with college training are under "Scientific Research" and the lowest, under "Public Health," where so much of the emphasis is on the paramedical personnel.

We've determined that the overwhelming proportion of college graduates work in the state sector, and it is interesting to note a few relationships—without giving them undue significance. If we use the approximate figure of 3,500,000 persons who had attended college (see table 4) and apply average percentages of enrollment in specific fields over a period of 30 plus years to that number, we get the following comparison between employment and graduates:

	Employment (from table 5)	Graduates (30-year average)
Engineers and technicians	1,037,000	1,155,000 (33%)
Medical personnel	432,000	385,000 (11%)
Scientists	251,000	245,000 (7%)

Perhaps it would be surprising if there was not a degree of correlation between these figures. A similar exercise cannot be done for "agrotechnical" personnel, because such a large proportion of graduates of agricultural colleges flee agricultural employment; teaching figures are selective and incomplete (see below).

Another distribution (not shown in table 5) of the 5,714,000 total scientific and technical personnel was given in a conference paper by Hu Ping, China's foremost specialist on professional manpower.[125] He states that of this total, 58,700 are senior scientists and technicians (equivalent to professor or associate professor), 987,300 are at the intermediate level (equivalent of university lecturers) and 4,664,000 are at the basic level. If we generously assume that all the senior and intermediate-level scientists and technicians have attended college and subtract this number (1,046,000) from the 2,495,000 total college graduates in table 5, the resulting figure, 1,449,000, implies that 31 percent of the basic-level scientific and technical personnel also attended college. Is this possible?

Now let us look more closely at the headings in table 5. The vertical categories obviously list the economic and government sectors which employ the personnel. It seems reasonable to assume that the last heading—Government Departments and Organizations—includes some individuals who are employed within the national defense system, which is not otherwise listed. The horizontal categories are not as clear, but seem to combine the activity in which the individuals are employed and their academic field.

The more one contemplates the table, the more questions come to mind, but just a few should illustrate the confusion. Where are the engineers, agronomists and medical doctors who are involved in research? Since industrial and construction ministries have their own research institutes, does this mean that engineers who may be doing research are included among the 15,000 persons in the "Scientific Research" sector, or are they part of the 1,229,000 engineering and technical personnel who work for "Industry and Construction"? If we take at face value Hu Ping's statement that there are "75,000 scientific research personnel working in industrial enterprises," then they must be included in the engineering total. The inclusion of "Scientific Research" in both the vertical and horizontal columns is especially baffling. Where, for example, are the researchers of the Chinese Academy of Sciences? Presumably among the 293,000, where the two columns intersect. But how about the researchers of the Chinese Academies of Agricultural Sciences and Medical Sciences? Since they are subordinated to the Ministry of Agriculture and the Ministry of Health respectively, are they included in the 5,000 and 16,000 personnel doing scientific research for the agricultural (3) and health (8) departments? The text only confuses the issue, because in citing the number of scientific and technical personnel who are "scientific researchers," it does not use 338,000 (the vertical total in table 5) or 346,000 (the horizontal total), or 293,000 (where the two columns intersect), but rather, it introduces yet another total of 330,000. Perhaps it is a rounding of one of the three figures in the table, but which one?

[125] Ibid., p. 5.

And who are the people in the "teaching" column? For comparative purposes, it should be noted that in 1980 the national distribution of teachers was as follow: 247,000 in higher education, 3,172,000 in all types of secondary schools, and 5,499,000 in primary schools.[126] Are the 1,291,000 scientific and technical personnel under "Teaching" teachers of scientific and technical subjects in higher and middle schools? Are they all teachers who are employed by educational institutions which are run by production ministries and enterprises? And to take this a step forward, do the 80,000 teachers who work for "Industry and Construction" teach only scientific and technical subjects, or are teachers of the Chinese language, for example, also included because they are paid by these institutions? Who are the 2,000 teachers employed by scientific research institutions? Perhaps some day our Chinese friends will straighten us out.

I must end this section of the report with a personal note. There is really no reason to be so critical of the statistics reported by the Chinese. First, they are doing their best and indeed no one can dispute the tremendous progress that has been made in the last few years in gathering, publishing, and sometimes even analyzing statistical data. Second, as already indicated, the problems may well be with the user of the statistics, rather than with the their producers. And finally, does it really matter? Does anything change, for example, if the number of scientific and technical personnel doing scientific research is 293,000, 330,000, 338,000, or 436,000? Of course not. The broad interpretations and conclusions about policies and problems are not affected by these minutiae. Thus, at least some of the criticism is a semi-conscious reflex which permits the frustrated analyst, who cannot avoid these issues, to let off steam.

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[126] *Education in China*, op. cit., p. 29.

PROBLEMS OF PLANNING AND UTILIZATION OF SCIENTIFIC AND TECHNICAL MANPOWER

The most fundamental challenge which planned economies must surmount is planning. The task of producing definitive plans that effectively match available resources with economic and social goals would be frustrating and distressing even in a small, homogeneous, politically stable country with a highly educated population. For China the task is virtually impossible now and an incredible challenge for the future.

One of the most difficult aspects of national planning relates to professional manpower. In this regard, the situation in China is about as far from ideal as can be imagined, and the creation of short- and long-term forecasts of the supply and demand for engineers, scientists, and other professional and middle-level manpower is just that—a creation. Nevertheless, China must plan—and would have to even if it were a market economy. Given the enormous manpower gap left by the Cultural Revolution and the unevenness of the existing professional manpower in terms of gross numbers, numbers within specific fields and disciplines, as well as quality, China cannot afford the luxury of random development of this vital resource. Although the planning process is aggravated by the fact that both the economy and the educational system are in a state of readjustment, it seems that each is attempting to make changes to accommodate the other. Leaders in education are continuously experimenting with methods that will make the system mesh with economic requirements, and the leaders within the economic sector must plan in a way that will realistically reflect the current deficiencies in manpower and take into consideration the quality and quantity of specialists expected to graduate in the years to come. Even so, there is pessimism about the future. Viewing the college graduates in three time categories—those who graduated between 1950 and 1963, between 1964 and 1976, and since 1976—Chinese observers have said "It is easy to forecast that between the years of 1985 and 1995 the first echelon will be too old, the second too poorly trained, and the third too inexperienced to take up the burden." [127]

There are a number of other general problems with which manpower planners must contend. China is both an advanced and a backward nation and her needs are varied. Even looking to the future, the educational system must reflect multiple requirements—requirements of the most modern as well as the obsolescent sectors of the economy. Then, there is the narrowness of technical education—a carryover from the Soviet influence of the 1950s. It is true that China cannot afford the luxury of an educational system that produces only highly trained generalists: her economy requires large numbers of middle-level specialists. But the difficulty of predicting needs for such narrow

[127] GMRB, Jan. 10, 1982; JPRS, No. 80,227, Mar. 3, 1982.

specializations as ore-dressing engineering, hydraulic engineering, sugar refining engineering, and so forth, is obvious.

Recognizing the problems associated with the development of human resources, China established the Institute of Human Resources (probably in 1981) and set up numerous local human resource study groups. According to Wang Kang, the Institute's director, there are "a number of problems which urgently require study and solution" in the field of training, employment, and management of human resources. The Institute's responsibility is to study these problems and provide the party and the state with recommendations which will result in realistic policies, especially with regard to the distribution and utilization of scientific and technical human resources. However, one of the handicaps to be overcome, according to Wang, is the attitude of some comrades who "view personnel and organizational work as incidental professional duties and see themselves and their fellow workers as 'tiger balm—panaceas,' refusing to admit that personnel management and organizational work are a separate profession and therefore lacking a new spirit of discovery and a desire for study." [128]

Despite the reluctance of some managers whose thought has become "semi-ossified," Beijing is attempting many innovations in order to bridge the training gaps and planning deficiencies. Here too many of the policies are in experimental stages, but, if successful, the greater professional mobility and flexibility now being tried should relieve the planners of at least some of their problems.

Enrollments Versus Requirements: The Matching Game

As with Chinese planning in general, we know much more about the problems associated with professional manpower planning than the details of the procedures. Nevertheless, based on several reports and discussions, it is possible to get a general idea of the "who" and the "how" of the planning process.

The development of scientific and technical manpower is so critical to China's national interests that the discussion, formulation, and even implementation of relevant policies have routinely involved the country's top leadership. The establishment of college enrollment plans and the assignment of college graduates involve the State Planning Commission, the State Economic Commission, the Ministry of Education, and the Ministry of Labor and Personnel. Also involved, though less directly, are all the other ministries and production and research organizations. Although some modifications are now being introduced, the basic procedure for establishing enrollment plans have not yet experienced any drastic changes. Through their own chains of command, ministries and institutions collect information from literally thousands of units around the country on requirements for specialists and pass it on to the State Planning Commission. Here the requirements are reviewed, adjusted in consultation with other commissions and bureaus, and passed on to the Ministry of Education for the formulation of the national enrollment plan. After the final plan is approved by the State Council, it is distributed to the education departments and universities in various localities.

[128] GMRB, Mar. 18, 1982; JPRS, No. 80,836, May 17, 1982.

The problems that ensue are quite predictable. The national enrollment plan has been formulated quite independently of the capabilities of the institutions of higher education, which, in turn, send up information to the Ministry of Education on the number of students they could accommodate in each discipline, based solely on the availability of facilities and the competence of their staff. If the plan formulated at the top happens to mesh with local capabilities, it is only fortuitous. For the most part, "the blindness in university enrollment" results in serious imbalances in the numbers of specialized personnel—with excesses in some areas and shortages in others. This then, creates enormous confusion with regard to the assignment of graduates to jobs.

This mismatch between the supply and demand of scientific and technical personnel is serious. In 1981 the provinces, municipalities and economics sectors requested 520,000 graduates: only 276,000 actually completed higher education that year. In China, college students can major in 840 specialties, which is recognized as being much too high, especially since students with narrow specializations have "a weak ability to adopt to jobs." In that year, the supply of graduates failed to meet the demand in 300 specialties and supply exceeded demand in 50 specialties, totaling about 10,000 graduates. The most severe shortages were reported to be in the mineral industry, in construction, in "light industry, textiles, geology, ordinary machine, food, and other sectors which have weak technical forces," as well as in political science. Excesses occurred in nuclear energy, nuclear physics, iron and steel smelting, several agricultural machinery fields, marine chemistry and geology, and computers.[129] This means, of course, that the needs of many units are not met and that many graduates are assigned to jobs for which they are not trained. Even prestigious Jiaotong University in Shanghai reports that 20 percent of the 500 graduates in 1981 were assigned to jobs unrelated to their studies.[130]

The process of planning and allocation is further complicated by another factor. All the college graduates of full-time institutions are included in the State Distribution Plan, which is the responsibility of the State Planning Commission, the Ministry of Education, and the Ministry of Labor and Personnel. And yet, a large proportion of them "have been supported during their studies by localities," which expect them to return and abide by local rather than national job allocation plans.[131] How this contradiction is finally resolved is difficult to assess.

The consternation of matching the supply and demand in scientific and technical personnel can be gleaned from the following excerpt from the *People's Daily*:[132]

> The situation now is that the people in charge of training personnel only care about the training end, and those in charge of job assignment only care about that. Those units responsible for the development of personnel are not aware of the state's needs, and the units in charge of work assignments, feeling as they do that it is difficult to arrange work for graduates, just assign them to work in the provinces and areas

[129] RMRB, Aug. 22, 1982; JPRS, No. 82,025, Oct. 20, 1982. Some variations on the shortages and excesses of graduates can be found in other sources.
[130] Xinhua, Jan. 21, 1981; JPRS, No. 82,897, Feb. 17, 1983.
[131] Xinhua, July 15, 1982; FBIS, July 16, 1982.
[132] RMRB, Oct. 26, 1982; JPRS, No. 82,590, Jan. 5, 1983.

> according to the number of students graduating, instead of assigning them to departments that need them and in accordance with the individual graduate's situation. Plus, personnel departments don't understand technology and frequently mismatch graduates and jobs. In Zhejiang one graduate who had studied silicates was sent to work in a seaside saltworks, just because "silicates" is written with characters that mean "silicic acid salts."

Such disarray gives rise to deception and a further breakdown of regulations, on the part of both the units requesting specialists and the graduates.

When factories and institutions compile their "wish lists" for specialists, they are well aware the requests will be drastically cut, so the managers adapt the ancient Chinese custom of haggling to the situation at hand. In order to come close to the number of new graduates they would like to have assigned they pad their requirements—a fact that was admitted in a discussion at one of the machine-building industries.

As for the graduates themselves, the standard response repeated by every college student for so many years—"I will serve wherever the motherland wants me to serve"—is no longer heard as often even by foreigners. It is said that "A small number of college graduates who seek ease and comfort and are afraid of a hard life often find excuses to stay in the cities and are unwilling to accept jobs assigned to them." How "small" the number is a moot point, but "after persuasion and education, they generally agree to go where they are assigned." [133] Nevertheless, it seems that every graduate whose family may have access to a "back door" will attempt to use it in order to get a job assignment to a leading organization, a scientific research and design unit, or to any other position in a prestigious institution in a large city. And the individuals most likely to have the influence are, of course, party members and cadres, "who abuse authority and use their pull, arranging work for their children, who use back-door or dishonest means to achieve their ends, and who vigorously promote unhealthy practices." [134] The same commentator points out that too many students (and youths in general) "would rather remain idle than do jobs which they consider to be 'lowly' or 'humble.'" To stress the error of this attitude (and, in this instance, probably not addressing college students) he quotes Liu Shaoqi, who once said "there is no difference between a state chairman and a nightsoil collector—it is just a question of division of labor." And who can argue with his assertion that sanitation workers "make 10,000 people clean by one person getting dirty." [135]

Apparently so many graduates from universities attempt to circumvent job assignments or simply refuse to abide by them, that a number of the provinces have established specific measures intended to thwart this practice. The one issued by the Sichuan provincial personnel bureau appears to be quite characteristic and includes the following points: 1. Leading cadres involved in allocating graduates are pro-

[133] BR, No. 37, Sept. 13, 1982.
[134] RMRB, Mar. 18, 1983; FBIS, Mar. 21, 1983.
[135] Ibid.

hibited from taking advantage of their position and power to get back-door benefits, from offering and receiving bribes, and from using crooked ways to interfere with the work of allocating graduates, especially when they are children of relatives and friends. 2. They must strictly observe security and not divulge to anyone the list showing names of graduates and job assignments. 3. Graduates are not allowed to find their own work units and no unit is allowed to give individual graduates work. 4. Graduates must be allocated according to their merit, according to the needs of the state, and into positions where their specialty will be fully utilized. 5. Graduates who disregard the need of the state, persist in their own unreasonable demands, and refuse to accept assignments, will be prevented from any employment by state-owned enterprises for a period of 5 years. 6. Anyone who disregards the above regulations should be "punished in accordance with the law." [136]

More important than the rules and regulations issued by provinces is the gradual introduction of national reforms with regard to education and job allocations, which are intended to facilitate the manpower planning procedures. The first of the changes, which are taking place at several levels, concerns itself with the management of universities. A commentary in *Guangming Daily* placed the primary blame for restricted development of higher education on the state because it "monopolizes too much and controls too rigidly," thus hampering initiative. It referred to a recent survey showing that "some universities rarely have any power of decision." To correct this situation three steps have been proposed and gradually and selectively implemented. To increase the enthusiasm of the administrators, they should be given more power with respect to enrollment of students, the employment, promotion, and transfer of teachers, and the distribution and expenditure of funds. To increase the enthusiasm of teachers, they must be allowed to change work and should be encouraged to take on part-time work, as long as their regular duties are not adversely affected. And to increase the initiative of students, they should be made to understand that a college degree does not automatically guarantee permanent employment. Apparently all these innovations have already been tested in Shanghai's Jiaotong University, which in 1982 decreased its staff by 33 percent, increased the volume of work by more than 30 percent, and, by rendering technical services, almost doubled its income from 800,000 to 1.5 million yuan. These reforms were therefore pronounced to be feasible.[137]

Other reforms which should alleviate the problem of matching demand and supply in professional manpower relate mainly to enrollment practices. One was already mentioned: the lowering of admission standards (examination grades) for applicants from rural areas, who would agree to return to the rural areas once they graduated from colleges of agriculture, forestry, medicine, and teaching. Some most of them are expected to return to the area from which they came, this should eliminate the need to include these students in the national graduate allocation plan. The other innovation just introduced by the Ministry of Education is for individual units—especially collec-

[136] Sichuan Radio, June 17, 1982; FBIS, June 22, 1982.
[137] GMRB, Jan. 27, 1983; FBIS, Feb. 4, 1983.

tively owned rather than state enterprises—to sign personnel training contracts with the colleges. In this way, the education can be tailored specifically to meet the needs of a particular unit or department, the colleges will receive direct payment for this service which can be used to up-grade the institution, and again the difficult process of allocating manpower at the national level can be by-passed.[138]

Improving the Distribution and Utilization of Scientists and Engineers

Just as important as the training and assignments of college graduates, is the proper utilization of scientists and engineers already in the labor force. As Deng Xiaoping pointed out, "It is not that we do not have talented people, the problem is whether we can better organize them and tap their initiative and use their talents to the full extent." [139] In other words, China must make sure that scientific and technical personnel are employed within their fields of specialization, that they are rationally distributed within the production and scientific establishments, and that they are efficiently utilized within the units and in their geographic locations.

Much of the responsibility for these difficult tasks rests with the State Bureau of Scientific and Technological Personnel—a rather inscrutable organization, seldom visited by foreigners. The Bureau (often referred to as the Cadres Bureau) was established in 1964, dismantled during the Cultural Revolution, and restored only during the late 1970s. But it did not last long and in late 1981, as part of the major reorganization of the government structure, the Cadres Bureau, along with the State Bureau of Labor, State Bureau of Personnel, and the Composition of Government Organization Commission, was absorbed by the new Ministry of Labor and Personnel. Curiously, during a visit to the Bureau in January 1981, no mention was made in the briefing or subsequent discussions about its changed status, unknown to us at that time. It was pointed out, however, that although this organization made an input into the annual manpower plan ("gave advice"), its primary duties had nothing to do with the training of new scientists and technicians (as has been generally assumed), but only with improving the qualifications and distribution of such personnel already employed in the various sectors of the economy. For a time, it was difficult to judge whether the Bureau and its functions would survive as an entity within the large organization or be otherwise apportioned. Apparently, despite its new subordination (which is said to have rankled its leadership), the Bureau of Scientific and Technological Personnel is intact and is still responsible for the ways and means of improving the utilization of existing manpower.

When the Chinese talk of "irrational distribution of scientific and technical personnel," they are referring primarily to three concerns: large versus small towns, coastal versus inland provinces, and the more glamorous and urban sectors versus the less-prestigious and rural sectors. Let us first describe the problems and then consider the current efforts to solve them.

[138] Xinhua, Mar. 16, 1983; FBIS, Mar. 21, 1983.
[139] Xinhua, Nov. 30, 1982; FBIS, Dec. 1, 1982.

Clearly the concentration of scientific and engineering manpower in large cities and in coastal provinces cannot be blamed on foreign exploitation prior to 1949 or on the "gang of four," as some Chinese commentators are still prone to suggest. After all, population follows arable land and in China the large cities grew in the rich, densely populated, coastal provinces. As part of the natural progression, industrialization occurred in the larger cities where the human creative energies also existed. The inequality was further accentuated by the priorities which for many years dictated the distribution of scientific and technical personnel: "military industry first, heavy industry next, and light last." [140]

Consequently, cities like Beijing and Shanghai have a relative excess of scientists, engineers, professors, and other intellectuals, while smaller cities (which in China may have populations of 100,000) may be assigned some graduates fresh out of colleges, but find it extremely difficult to lure mature and experienced professionals from the large cities. This problem has become particularly acute now that China is pursuing a policy emphasizing light industries, many of which are located in medium-size and small cities. In October 1982 China even held a national conference specifically on the scientific and technological work in small and medium-size cities and their importance as bridges and links between large cities and rural areas.[141]

What about the provincial redistribution of scientific and technical manpower? Ever since the 1950s, Beijing has pursued policies designed to exploit the natural resources and develop the economic base of the border provinces. We know that over the past 30 years there has been a modest flow of professionals to the north and west—some of it undoubtedly forced and some in response to special incentives, but the volume of this movement is not known. It is difficult to determine whether the shortage of scientific and technical manpower in the border provinces is more acute than in the eastern regions, but given the relative levels of development and the fact that most of the personnel are supplied by the local universities and colleges, the problem of quality is probably more serious than the problem of quantity.

As for the disparity in the numbers of scientific and technical personnel in specific economic sectors, the primary focus is clearly on the overconcentration of specialists in heavy as opposed to light industry, and the shortage of specialists working in agriculture.

Because of the priority of the defense industries and the past emphasis on heavy industry, next to working in an institute of one of the academies, the greatest prestige, compensation, and potential went with employment in these sectors and that is exactly where the scientists and engineers concentrated. Consequently, by 1980, light industry accounted for 46.9 percent of the gross industrial product, but employed only 15.5 percent of scientific and technical personnel,[142] of whom only 1.9 percent had a college education.[143] A striking example of the inadequacy of professional personnel in the light industry was reported for Anhui Province. Of the 160,000 workers who belong to

[140] *Kexuexue Yu Kexue Jishu Guanli (Scientology and Management of Science and Technology)*, No. 4, July 20, 1982; JPRS, No. 83,240, Apr. 12, 1983.
[141] RMRB, Oct. 22, 1982; FBIS, Nov. 10, 1982.
[142] GMRB, Mar. 18, 1982; JPRS, No. 80,836, May 17, 1982.
[143] *Kexuexue Yu Kexue Jishu Guanli (Scientology and Management of Science and Technology)*, No. 4, July 20, 1982; JPRS, No. 83,240, Apr. 12, 1983.

the newly established Society for Light Industry, an incredibly low 0.31 percent had any specialized knowledge.[144]

In agriculture, the conditions are at least as bad as in light industry. Again in 1980, there were about 320,000 scientific and technical personnel on both collective and state farms in China—about 4 per 10,000 people in the rural areas. Their qualifications are generally low, as are their working and living conditions. To make matters worse, from 1979 to 1980 there was an actual decline of 4.2 percent in agricultural scientific and technical personnel in the communes.[145] This is not surprising and Chinese colleagues, at least in private conversations, are quite frank in discussing this problem. The disparity between urban and rural living in China is enormous and it is difficult to recruit students to major in any field that would require them to live in the countryside. Even if they are assigned to study agricultural sciences, they will do everything possible to try to remain in the city after graduation. Presumably many such graduates would rather be clerks in a department store than scientists on the farm. This is confirmed by a report that of the "more than 700,000 scientific and technical personnel in agriculture, forestry and stockbreeding" who graduated from universities and secondary vocational schools since 1949, "only 280,000 remain on the agricultural and stockbreeding fronts, 60 percent having changed trades." [146] Furthermore, although the countryside urgently needs scientists and technicians, for some unknown reason many of the graduates of agricultural vocational schools are not assigned, while among the "returned graduates, rehabilitated soldiers, and skilled artisans there are a great many scientific and technical personnel who are only partially or not at all engaged in production. . . ." [147] Although living conditions in the countryside have been improving in the last few years, the only way to fill the ranks of rural specialists is to recruit rural youth, send them to agricultural vocational schools and agricultural colleges (preferably not located in cities), and then make sure that they return to the region of their origin. The new regulations, discussed earlier, which lower the college entrance requirements for rural youth who promise to return to the countryside, should gradually meet the "greatly aroused demand of the broad masses of peasants for scientific farming," but the shortage will persist well into the future.

When Premier Zhao Ziyang points out, as have other officials before him, that "it is imperative to organize the efforts to transfer scientific and technological results from laboratories to production, from military use to military-civilian use, from coastal areas to inland areas, and from foreign countries to China," [148] he is also indirectly making a plea to maximize utilization of China's scientific and engineering manpower by sharing this scare resource. But how to entice the scientific and technical personnel—who are now feeling their oats—into localities and or positions which do not appeal to them? And in

[144] *Ziran Bianzhengfa Tongzun* (*Journal of Dialectics of Nature*), No. 2, 1981; JPRS, No. 79,115, Oct. 1, 1981.
[145] GMRB, Mar. 18, 1982; JPRS, No. 80,836, May 17, 1982.
[146] GMRB, Nov. 15, 1982; JPRS, No. 82,440, Dec. 10, 1982. A later report gives the two figures as 800,000 and 300,000 respectively—suggesting an even more severe defection from agriculture. (RMRB, Apr. 16, 1983; FBIS, Apr. 21, 1983).
[147] GMRB, Nov. 15, 1982; JPRS, No. 82,140, Dec. 10, 1982.
[148] RR, No. 46, Nov. 15, 1982.

general, how do you overcome the traditional immobility of personnel in China? After spending several months conducting field research on planning and management of the Yangtze River Basin, Mike Lampton writes: [149]

> Most of the persons I met in Chinese bureaucracies have *never* worked outside the organization in which they presently are employed. Indeed, most have worked in the very same bureau for their entire post-Liberation careers. There virtually is no organizational or educational cross-fertilization that I could discern.

Despite these handicaps, the leadership in Beijing is announcing numerous innovations, experimenting with a variety of incentives, and attempting to introduce tremendous flexibility in the employment picture.

In early 1982, two provisional regulations were promulgated by none other than the State Bureau of Scientific and Technical Personnel to address these problems. They first dealt with the hiring of part-time scientists and technical personnel, stipulating that "On the basis of their need for science and technology work, units in scientific research, teaching, public health, and industrial and agricultural production may temporarily hire intermediate and high-level scientists and technical personnel as advisers, or to teach, give lectures, and do scientific research and design work on a part-time basis." Since such outside activities must not adversely affect work performance in his own unit, this can be done only with the dual consent of the individual and of the unit in which he works. The impression is that the amount of time spent away from home base is negotiable between the lending and borrowing units. In theory at least, as long as the individual completes his regular work, he may work part-time elsewhere. And the incentive for working two jobs is universally acceptable: "certain material remuneration."

The second regulation deals with the exchange of scientists and technical personnel, and it stipulates that ". . . the departments in charge of scientific and technical personnel in various units may organize scientists and technical personnel to work for other units at regular intervals in a planned manner." Planned though they may be, there is considerable flexibility in these contractual arrangements: "According to needs in fulfilling scientific and technological tasks and the situation of surplus or shortage of scientists and technicians, short- or long-term contracts for scientific and technical cooperation, technical and economic contracts, contracts for temporary transfer and contracts for part-time hire may be signed between one district and another, one department and another, and one unit and another for the exchange of scientists and technical personnel." Contracts are required to be quite explicit with regard to sphere or cooperation, responsibilities, and, most important, how to remunerate the unit which loans the "consultant" and "how to deduct a suitable portion to reward participating scientists and technicians." [150]

[149] David M. Lampton, "Observing Chinese Politics From the Yangtze Basin," *China Exchange News*, June 1983.
[150] Xinhua, March 23, 1982; FBIS, March 25, 1982.

As usual, however, every action causes reaction. People of talent are "owned by the units to which they belong" and even though some specialists "actually have nothing much to do and cannot put their energies to use . . . when other units want them, they [the owning units] will not let them go" [151]—just in case they might need their services in the future. I ran across a first-hand example of this problem on a train ride through central China in November 1982. In a bunk across from me was a mining engineer from Shandong Province, who had worked for many years in a coal mine that had been opened during the Cultural Revolution. In 1980, the provincial authorities determined that the mine was not efficient enough to continue its operation and shut it down. In the intervening two years my companion has been unemployed, while drawing his regular engineer's salary. He has repeatedly made requests for a transfer to another locality where he would be able to work within his specialty, but the unit which "owns him" will not give him a release, without which he cannot move.

The problems of competition and jealousy are no doubt evident in all sectors, but they seem to be especially grating in the scientific and technical establishment, where the potential of each individual is considerably broader. First, there is competition between production enterprises and research institutions, which was scored even by Premier Zhao Ziyang in his address to the National Science Awards Conference in 1982,[152] but with the profit factor becoming more and more important, it will take constant prodding to make the managers share their scientific and technical talent with competitors. There is also jealousy between individuals, which often prevents the most competent people from reaching their potential. This was described by Zhang Aiping, Chairman of the National Defense Scientific and Technological Commission, in his address to the China Society of Human Resources Management: [153]

> To select talented people for appointment it is necessary to do away with the bad habit of scholars tending to scorn each other and persons of the same trade tending to exclude each other. Being jealous of able and virtuous persons is an unhealthy trend and evil practice left over from the old society that must be completely eliminated. Some people are jealous of younger persons or their contemporaries for fear that the latter will surpass them. Some others, who are even more despicable, make slanderous, ironical or satirical remarks about others . . . .

There is little solace to be found in the universality of human nature.

Perhaps managers of production enterprises are beginning gradually to understand that some scientists and engineers from academy institutes and universities, isolated as they are from the "real world," may still be helpful in coping with some of the daily problems of production. But the reluctance of academics to get involved in production problems is not decreasing. To the point is a recent example

[151] RMRB, Jan. 11, 1983; FBIS, Jan. 14, 1983.
[152] BR, No. 46, Nov. 15, 1982.
[153] Xinhua, Jan. 18, 1983; FBIS, Jan. 20, 1983.

reported in the *People's Daily*.[154] Both the Panzhihua Iron and Steel Academy and the Panzhihua Iron and Steel Corporation are located in Dukou Municipality in Sichuan Province. After years of administrative shuffling, both were placed under the Ministry of Metallurgical Industry in 1978. When it comes to scientific and technical manpower, however, the Academy has a "storehouse of talent," with very few scientific research tasks to perform, while the iron and steel plant "has a pressing need for scientific research talent." Although the blame for the phenomenon of "jobs with nobody to do them, and people with no jobs to do," is rightly placed on the leadership which created two units without any formal administrative relationship, we can be sure that any initiative for a change which might deploy scientists and engineers into production and construction activities, would not be initiated by the managers or researchers of the Academy.

Of all the "iron rice bowls" in China, those most secure belong to academicians. Once a scientist receives an appointment to one of the institutes, he is set for life; he cannot be fired or transferred. Naturally then, major changes and considerable pressures are required to induce such an individual to leave his "ivory tower" and get involved in the practical problems of the country's economy. It is therefore especially significant that more and more examples are being reported of academics leaving their sinecure for distant places and undesirable assignments. For example, the President of the Shanghai Branch of the Academy of Sciences said in an interview that "in the past four years 581 people have been transferred away from Shanghai research institutes . . . from bigger to smaller cities, from coastal areas to the hinterland, and from institutes with a high concentration of experienced researchers to places where researchers are lacking."[155] At the same time, researchers who remain are now "encouraged to teach, offer consultancy services, or join with others to tackle scientific problems in their spare time." Although the report uses the word "some," it is probably more accurate to say that "most" of the transfers "were carried out on orders from higher authorities." There is, however, one very important conciliatory gesture or arrangement that is made to make the forced moves more palatable. Apparently, in many cases, the individual's affiliation with the Academy of Sciences is not severed and he assumes the new positions with many of the same perquisites he had in Shanghai, Beijing, or any other major center from which he was transferred. This is a face-saving device of considerable consequence.

Innumerable organizational arrangements have been created to facilitate the involvement of scientific and technical personnel with the immediate needs of enterprises and institutions which have been handicapped by a shortage of such personnel. There are advisory and consulting organizations which examine plans and advise on technical problems; there are joint ventures between production and research units to develop new technologies, new products, and testing procedures; arrangements are made for the technologically advanced areas

[154] RMRB, Jan. 13, 1983; JPRS, No. 82,991, Mar. 2, 1983. For a more general discussion of this issue, see Leo A. Orleans, "Science, Elitism and Economic Readjustment in China," *Science*, Jan. 29, 1982, pp. 472–477.
[155] CD, Feb. 6, 1983.

to provide personnel and equipment to the less developed areas; there are technical development centers, enabling large enterprises to share their facilities and personnel with smaller units; and so forth. In large part because of this flexibility, there are enough success stories to indicate that the carrots and sticks built into the system are adequate encouragement to experiment with the new regulations and seek ways to overcome the resistance which still exists among many of the principal participants.

A good example of the various methods now being used can be seen from the experience of Tonghua, a municipality in Jilin Province in northeast China. This "rapidly growing medium-size city" (estimated to have over 300,000 inhabitants) had fewer than 1,000 engineers and technicians and was in great need of personnel with technical skills. In 1982 the Tonghua Municipal Committee and Government, with the support of the Ministry of Labor and Personnel and other ministries and universities located in Beijing, made a decision to recruit scientific and technical personnel from Beijing and other large cities. Such an individual could transfer permanently to Tonghua or come on a temporary assignment under a contract with his original unit. Recent graduates are not invited, however, for the city is obviously looking for mature, experienced people, "who are in the prime of life" and who graduated from institutions of higher learning prior to 1966. To entice these specialists, the city promises them 50 square meters of living space—which is significantly larger than they would have in Beijing, "special arrangements for sons and daughters awaiting work," and a provision to transfer the spouse as well (presented in the order given). The perquisites must be meaningful indeed: in just 4 months, 140 scientists and technicians from the Beijing area had indicated their willingness to work in Tonghua.[156]

While the distinguishing characteristics of each of the approaches listed in an item from Heilongjiang are not entirely clear, innovation and flexibility are certainly emphasized. Seven ways are suggested in which industrial enterprises can "give full scope to the wisdom and talent" of scientific and technical cadres. They can transfer personnel, borrow them for specific projects, recruit them, rely on voluntary help, contract with other enterprises for the use of specialists, arrange for joint projects, and raise the competence of personnel through training.[157]

A good example from the academic perspective is Jiaotong University, one of China's leading institutions of higher education. Jiaotong's new Technical Service Department, which does outside consulting work, earned 1.5 million yuan ($750,000) in 1982 from research projects, training technicians, technical consulting, and translation work. As a result the university was able to give 176,000 yuan in bonuses to faculty and staff, according to the contribution made. The Huadong Institute of Chemistry, also in Shanghai, has entered into a cooperative relationship with a petrochemical corporation and with two nearby counties. Under the agreement, the parties will cooperate in the fields of research, technical exchange, consultant services, and personnel training and will share both expenses and income.[158]

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[156] *Beijing Ribao (Beijing Daily)*, Aug. 17, 1982; JPRS, No. 82,502, Dec. 20, 1982.
[157] *Heilongjiang Ribao (Heilongjiang Daily)*, Sept. 6, 1982; JPRS, No. 82,204, Nov. 9, 1982.
[158] CD, Feb. 7, 1983.

Finally, yet another innovative approach to diffusion of technology and know-how was the creation of a think-tank in Beijing's northwest suburbs, where many universities and research institutes are located. "Advanced Technology Development and Service Cooperation," under the Beijing Association of Science and Technology, provides consultation, technical know-how, and services to factories for the development of new products. In the past two years, 20 contracts were signed with industrial groups. Scientists and professors work in the think-tank in their spare time, the enterprise is completely self-supporting, and when the contracted work is completed, bonuses are shared with factory workers participating in the project.[159]

There is no better way to summarize the issues and, at the same time, indicate the importance with which the leadership views improvements in the utilization of scientific and technical manpower, than to quote from Premier Zhao Ziyang's "Report on the Work of the Government," delivered on June 6, 1983 to the Sixth National People's Congress:[160]

> The most pressing problem confronting us is the unified arrangement and proper use of scientific and technical personnel. In order to do this, we will take the following measures: 1) Break down the barriers between departments and between regions and work out unified placement and appropriate use of scientific and technical personnel on a nationwide scale through the drawing up of the development programme, the joint tackling of key scientific and technical projects and establishment of technological development centres. 2) Transfer in a planned way a number of scientific and technical personnel from heavy and defence industries to energy, transport, light industry and agriculture where such personnel are few; transfer a number of personnel from institutions of higher education and scientific research that are well staffed to secondary schools or vocational schools to augment their teaching staff. 3) Set up a system of rational interflow of scientific and technical personnel so that they can move from overstaffed to understaffed departments and to encourage them to go to small and medium-sized cities, the rural areas, national minority areas and remote border regions. 4) Create a system of dual control over the country's scientific and technical personnel, grading them according to whether they come under the management of the central or local authorities and according to their trades or professions and specialities. 5) Improve the systems of appraisal, promotion and awards and the conferring of academic titles on scientific and technical personnel so as to raise the professional competence of those who are young and middle-aged.

Indeed, provided they work, it would be difficult to find fault with the creative policies now being tested by Beijing to improve the utilization of China's scarce manpower resources.

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[159] CD, Feb. 19, 1983.
[160] BR, No. 27, July 4, 1983, p. XVIII.

PROSPECTS

After spending many months immersed in a topic, there is a temptation to overemphasize its significance. In this intsance it would be easy to conclude that the shortages, the poor quality, and the inefficiencies associated with scientific and technical personnel have been the primary impediment to China's economic growth and modernization, especially since the Cultural Revolution. Important as they are, in fairness it must be said that other constraints—all of them interrelated and retarding economic development—are much graver in terms of China's future. Among them are budgetary insufficiencies, energy shortages, difficulties associated with the exploitation of natural resources, current employment plus the need to create jobs for 15 to 20 million youths every year, and the ever-present requisite for increased agricultural production to feed over one billion people. What distinguishes the deficiencies in scientific and engineering personnel from the other serious problems is that, by comparison, it is much more manageable, and it is quite possible that by the end of this decade an adequate accommodation will be reached between the demand and supply of scientific and technical manpower in China.

The key word here is "accommodation," which does not mean that all complaints about the quantity and quality of personnel will cease—an unrealistic expectation for any country. Neither does it mean that China will reach some internationally acceptable ratio of scientists and engineers to population or to the labor force. If judged on the basis of international per capita standards, China is likely to be near the bottom of any list of nations for a long time to come. In other words, in this instance as in most others, the temptation to make statistical comparisons between China and other countries should be resisted, unless the figures are accompanied by massive textual interpretations. What is meant by "accommodation" is that by pursuing diversified and imaginative policies toward education and training on the supply side, and toward utilization on the demand side, the professional manpower constraint will no longer be an important inhibitor of economic modernization.

In response to Beijing's demand that the nation's economy must be the focus of scientific and technical work, the educational and economic sectors are attempting to work together and to anticipate and accommodate each others' needs. Fortified with more direct control and coordination functions, the State Planning Commission and other high level national organs have been able to facilitate—sometimes through voluntary and sometimes through forced compliance—cooperation between the two sectors. As a result, considerable progress has been made in the educational planning process and some modicum of order and rationality is being introduced into the allocation and utilization of scientific and technical personnel.

The incredibly diverse educational system is attempting to provide both high- and middle-level manpower for the modern and the not-so-modern sectors of the economy. This is being done by maintaining a reasonable equilibrium between key schools and ordinary schools, between general and vocational education, between urban and rural schools, and by continuously adjusting the system as problems arise and requirements change. At the same time that enrollment in the institutions of higher education is expected to increase by about 100,000 per year (on the average) for the next eight years, the Ministry of Education and the production ministries and enterprises are collaborating in creating a multiplicity of ways in which professionals and non-professionals alike, can up-grade their on-the-job qualifications or continue to raise their formal educational level. Special attention is being given to raising the competence of individuals who graduated from colleges during the 1970s. Whether they are attending spare-time or part-time classes, or are registered for correspondence or radio-TV courses, one gets the impression (no doubt an exaggerated one) that virtually the whole urban labor force is involved in some form of education or training.

In addition to providing their workers and employees with a variety of opportunities for continuing education and coordinating these activities with the educational establishment, the ministries, enterprises, and institutions are increasingly improvising the ways in which scientific and technical personnel are utilized within the unit and, in response to considerable arm-twisting, devising ways in which they could be shared with other units in need of their know-how. In any case, as a result of a far-ranging and diversified system of contractual arrangements, by introducing incentives (salaries, bonuses, perquisites, etc.), and in general, by releasing the pent-up entrepreneurial spirit and talent of the Chinese people, the leadership is increasing productivity and progressively achieving a more rational distribution of the scientific and technical personnel.

We know that the growth potential of the modern sector of China's economy is circumscribed by budgetary deficiencies, population size, and other constraints for which there are no quick solutions. Consequently, by expanding and improving the system of higher education, and by up-grading the qualifications of scientific and technical personnel already employed, the reservoir of these specialists is being replenished at the same time that new directives are increasing organizational flexibility and professional mobility. It is true that most of the education currently being provided in the country will not produce graduates who are likely to expand the horizons of science. However, discounting some notable exceptions, China does give adequate priority to select universities and institutes which continue to educate the research scientists in numbers that seem to be compatible with policies which place economic priorities above competition in world science.

The suggestion that China is gradually closing its scientific and technical personnel gap and that by the end of the 1980s this problem will lose its urgency should hold only so long as Beijing continues to maintain a realistic perception of the country's capabilities and consequently formulate matching and pragmatic goals.

APPENDIX A

China's Key Universities and Colleges

COMPREHENSIVE UNIVERSITIES

1. Sichuan University, Chengdu, Sichuan
2. Yunnan University, Kunming, Yunnan
3. Northwest China University, Xian, Shaanxi
4. Xinjiang University, Urumqi, Xinjiang
5. Lanzhou University, Lanzhou, Gansu
6. Wuhan University, Wuhan, Hubei
7. Xiangtan University, Xiangtan, Hunan
8. Zhongshan University, Guangzhou, Guangdong
9. Fudan University, Shanghai
10. Nanjing University, Nanjing, Jiangsu
11. Xiamen University, Xiamen, Fujian
12. Shangdong University, Jinan, Shandong
13. Beijing University, Beijing
14. People's University of China, Beijing
15. Nankai University, Tianjin
16. Inner Mongolia University, Inner Mongolia
17. Jilin University, Changchun, Jilin

INSTITUTIONS OF SCIENCE AND TECHNOLOGY

1. Chongqing University, Chongqing, Sichuan
2. Chengdu University of Science & Technology, Chengdu, Sichuan
3. Southwest China Jiaotong University, Emi County, Sichuan
4. Chengdu Institute of Telecommunication Engineering, Chengdu, Sichuan
5. Chongqing Architectural Engineering Institute, Chongqing, Sichuan
6. Xian Jiaotong University, Xian, Shaanxi
7. Northwest China Institute of Technology, Xian, Shaanxi
8. Northwest China Institute of Telecommunication Engineering, Xian, Shaanxi
9. Northwest China Institute of Light Industry, Xianyang, Shaanxi
10. Central China Institute of Technology, Wuhan, Hubei
11. Wuhan Institute of Water Conservancy & Electric Power, Wuhan, Hubei
12. Wuhan Institute of Geodesy, Photogrammetry & Cartography, Wuhan, Hubei
13. Wuhan Geological Institute, Wuhan, Hubei
14. Wuhan Institute of Building Material Industry, Wuhan, Hubei
15. Hunan University, Changsha, Hunan
16. Central South China Institute of Mining & Metallurgy, Changsha, Hunan
17. South China Institute of Technology, Guangzhou, Guangdong
18. Tongji University, Shanghai
19. Shanghai Jiaotong University, Shanghai
20. East China Institute of Chemical Technology, Shanghai
21. East China Textile Institute, Shanghai
22. Nanjing Institute of Technology, Nanjing, Jiangsu
23. East China Institute of Water Conservancy, Nanjing, Jiangsu
24. Nanjing Institute of Meteorology, Nanjing, Jiangsu
25. Nanjing Institute of Aeronautics, Nanjing, Jiangsu
26. East China Institute of Engineering, Nanjing, Jiangsu
27. Zhenjiang Institute of Agricultural Machinery, Zhenjiang, Jiangsu
28. China Mining Institute, Xuzhou, Jiangsu
29. Zhejiang University, Hangzhou, Zhejiang
30. Hefei Polytechnical Institute, Hefei, Anhui
31. University of Science & Technology of China, Hefei, Anhui
32. Shandong College of Oceanography, Qingdao, Shandong
33. East China Petroleum Institute, Dongying, Shandong
34. Qinghua University, Beijing
35. Beijing Institute of Aeronautics, Beijing
36. Beijing Institute of Iron & Steel Technology, Beijing
37. Beijing Institute of Technology, Beijing

38. Beijing Institute of Post & Telecommunications, Beijing
39. Beijing Institute of Chemical Technology, Beijing
40. North China Jiaotong University, Beijing
41. Beijing Institute of Agricultural Mechanization, Beijing
42. Tianjin University, Tianjin
43. North China Institute of Electric Power, Baoding, Hebei
44. Dalian Institute of Technology, Dalian Liaoning
45. Northeast China Institute of Technology, Shenyang, Liaoning
46. Dalian Marine College, Dalian, Liaoning
47. Fuxin Mining Institute, Fuxin, Liaoning
48. Jilin Polytechnical University, Changchun, Jilin
49. Changchun Institute of Geology, Changchun, Jilin
50. Harbin Institute of Technology, Harbin Heilonjiang
51. Northeast China Heavy Machinery Institute, Fulaerji, Heilongjiang
52. Harbin Ship Engineering Institute, Harbin, Heilongjiang
53. Daqing Petroleum Institute, Daqing, Heilongjiang

INSTITUTIONS OF AGRICULTURE AND FORESTRY

1. Southwest Agricultural Institute, Chongqing, Sichuan
2. Northwest Agricultural Institute, Wugong, Shaanxi
3. Central China Agricultural Institute, Wuhan, Hubei
4. South China Agricultural Institute, Guangzhou, Guangdong
5. Nanjing Agricultural Institute, Nanjing, Jiangsu
6. Jiangxi Agricultural University, Nanchang, Jiangxi
7. Beijing Agricultural University, Beijing
8. Beijing Institute of Forestry, Beijing
9. Shanxi Agricultural University, Taigu, Shanxi
10. Shengyang Agricultural Institute, Shengyang, Liaoning

MEDICAL COLLEGES

1. Sichuan Medical College, Chengdu, Sichuan
2. Zhongshan Medical College, Guangzhou, Guangdong
3. Shanghai First Medical College, Shanghai
4. China Capital Medical University, Beijing
5. Beijing Medical College, Beijing
6. Beijing College of Traditional Chinese Medicine, Beijing

NORMAL AND OTHER UNIVERSITIES

1. Southwest Institute of Political Science & Law, Chongqing, Sichuan
2. East China Teacher's University, Shanghai
3. Shanghai Institute of Foreign Languages, Shanghai
4. Beijing Normal University, Beijing
5. Beijing Institute of Foreign Languages, Beijing
6. The Central Institute for Nationalities, Beijing
7. International Relations Institute, Beijing
8. Beijing Institute of Foreign Trade, Beijing
9. Beijing Physical Culture Institute, Beijing
10. Central Music Conservatory, Beijing

APPENDIX B

A book published in Beijing in 1982, entitled Zhongguo Gaodeng Xuexiao Jiangjie 1980 (A Brief Introduction to Chinese Institutes of Higher Education 1980), first turned up in Washington in the spring of 1983—when the present manuscript was already at the printers. Most of the book is devoted to institutional profiles of individual universities and colleges, but the first 14 pages contain charts and statistical tables which include some previously unavailable figures. Fortunately, while they might have been incorporated into the text, they do not change either the analysis or the conclusions and only partially contradict the statement that "China has yet to publish a single compilation of statistics on higher education." page 18. Some of the statistics would be of interest, however, to individuals who may not have access to the original source, so that selected tables are included in this appendix.

TABLE B-1.—PROVINCIAL DISTRIBUTION OF INSTITUTIONS OF HIGHER EDUCATION

	1949	1952	1957	1965	1976	1978	1980
Total	205	201	229	434	392	598	675
Beijing	15	25	31	53	24	36	50
Tianjin	8	7	6	13	10	11	17
Hebei	3	4	4	12	22	29	27
Shanxi	1	3	4	11	11	16	16
Inner Mongol		3	4	8	7	8	14
Liaoning	8	17	14	26	24	34	36
Jilin	6	7	7	17	12	26	25
Heilongjiang	6	9	7	19	19	24	28
Shanghai	37	17	18	24	16	26	32
Jiangsu	15	17	15	30	25	35	42
Zhejiang	5	5	8	13	11	19	22
Anhui	2	3	5	12	12	20	22
Fujian	8	5	4	10	7	15	16
Jiangxi	5	4	4	12	10	17	17
Shandong	7	7	7	16	19	31	34
Henan	2	4	7	12	12	22	25
Hubei	10	10	18	23	22	34	36
Hunan	2	4	6	12	16	22	22
Guangdong	12	11	7	21	20	29	30
Guangxi	3	4	3	10	9	16	18
Sichuan	36	19	21	30	26	40	43
Guizhou	3	3	3	6	8	14	15
Yunnan	3	2	4	6	9	15	17
Tibet					3	4	4
Shaanxi	3	6	12	21	16	24	33
Gansu	4	4	4	7	8	11	12
Qinghai			1	2	4	6	6
Ningxia				1	3	4	4
Xinjiang	1	1	5	7	7	10	12

TABLE B–2.—DISTRIBUTION OF INSTITUTIONS OF HIGHER EDUCATION BY SPECIALIZATION

	Total	Comprehensive universities	Science and technology	Agriculture	Forestry	Medicine	Teachers colleges	Language and literature	Finance and economics	Political science and law	Physical education	Art	Other
1949	205	49	28	18	—	22	12	11	11	7	2	18	27
1950	193	50	27	17	—	26	12	8	12	3	2	18	20
1951	206	47	36	15	—	27	30	8	19	1	1	18	4
1952	201	22	43	25	3	31	33	8	12	3	2	15	4
1953	181	14	38	26	3	29	33	8	6	4	4	15	1
1954	188	14	40	26	3	28	39	8	5	4	6	14	1
1955	194	14	42	26	3	28	42	8	5	5	6	14	1
1956	227	15	48	28	3	37	55	8	5	5	6	16	1
1957	229	17	44	28	3	37	58	8	5	5	6	17	1
1958	791	27	251	96	13	134	171	5	12	5	21	28	28
1959	841	29	274	99	14	142	175	5	13	5	24	33	28
1960	1,289	37	472	180	24	204	227	8	25	9	30	45	28
1961	845	32	269	106	13	158	163	6	17	4	20	38	19
1962	610	31	206	69	9	118	110	6	17	3	11	28	2
1963	407	29	120	44	8	85	61	6	16	4	10	22	2
1964	419	29	122	44	8	85	59	14	18	6	10	22	2
1965	434	29	127	45	8	92	59	16	18	6	10	22	2
1971	328	27	115	31	3	78	44	7	2	—	5	12	4
1972	331	27	116	32	3	78	44	8	2	—	5	12	4
1973	345	28	118	34	3	78	45	10	4	—	6	13	6
1974	378	29	120	37	4	85	57	10	6	—	7	14	9
1975	387	29	123	38	5	88	58	10	6	—	7	14	9
1976	392	29	126	38	5	89	58	10	7	—	7	14	9
1977	404	29	132	38	5	89	59	10	7	1	7	18	9
1978	598	32	184	50	8	98	157	10	21	2	8	19	9
1979	633	33	191	52	9	107	161	10	22	6	11	22	9
1980	675	32	203	56	10	109	172	10	30	7	11	26	9

TABLE B–3.—PROVINCIAL DISTRIBUTION OF STUDENTS IN INSTITUTIONS OF HIGHER EDUCATION

	1949	1952	1957	1965	1976	1978	1980
Beijing	14,700	30,600	79,700	108,700	45,700	64,500	83,000
Tianjin	4,200	7,500	15,500	22,400	18,900	29,400	29,900
Hebei	1,100	2,600	6,600	22,700	19,900	30,100	41,500
Shanxi	900	2,100	7,300	14,100	12,700	20,600	33,100
Inner Mongolia		500	2,900	8,600	6,000	9,900	17,400
Liaoning	6,500	16,300	25,900	37,100	40,400	53,000	63,300
Jilin	4,200	9,000	18,200	26,000	24,500	31,600	38,000
Heilongjiang	5,900	9,300	17,800	32,900	23,500	34,600	43,600
Shanghai	20,900	21,300	38,700	52,000	33,600	50,000	73,400
Jiangsu	7,200	11,300	29,300	40,700	37,400	60,500	82,500
Zhejiang	3,400	4,500	12,300	16,500	10,500	24,200	37,600
Anhui	1,100	2,500	8,600	18,200	18,300	29,600	37,600
Fujian	3,900	4,700	7,500	15,200	11,400	31,100	38,600
Jiangxi	2,100	3,000	4,300	11,800	12,000	21,800	35,600
Shandong	3,900	6,800	12,600	22,200	21,300	38,400	51,400
Henan	700	2,100	9,600	14,000	20,100	27,300	45,000
Hubei	4,300	8,900	29,300	35,600	30,700	49,500	65,300
Hunan	2,700	6,100	13,600	20,700	25,500	36,100	52,000
Guangdong	5,800	9,900	14,600	28,800	24,000	36,000	44,100
Guangxi	2,000	2,400	3,900	7,800	14,700	21,100	25,500
Sichuan	14,000	14,900	35,500	45,700	43,400	57,200	74,400
Guizhou	1,000	3,300	3,500	6,800	8,300	13,900	17,100
Yunnan	1,700	1,400	7,000	9,400	11,000	15,900	18,100
Tibet				400	2,500	2,100	1,500
Shaanxi	2,300	6,300	25,000	35,700	25,700	37,100	53,200
Gansu	1,600	2,800	7,300	11,500	11,500	14,100	18,100
Qinghai			200	600	2,500	3,500	4,200
Ningxia				1,000	2,100	2,900	4,200
Xinjiang	400	900	4,500	7,200	6,600	10,300	14,200
Total	116,500	191,100	441,200	674,400	564,700	856,300	1,143,700

TABLE B–4.—STUDENT ENROLLMENT BY FIELD OF SPECIALIZATION

	1949		1952		1957		1965		1976		1978		1980	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Engineering	30,000	26.0	66,000	34.8	163,000	37.0	295,300	43.8	198,100	35.1	287,600	33.6	383,500	33.5
Agriculture	9,800	8.4	13,300	6.9	33,800	7.7	53,500	7.9	50,500	8.9	53,700	6.3	70,500	6.2
Forestry	500	0.5	2,200	1.1	6,100	1.4	9,800	1.5	8,600	1.5	7,900	0.9	11,700	1.0
Medicine	15,200	13.1	24,700	13.0	49,100	11.1	82,900	12.3	98,400	17.4	113,000	13.2	139,600	12.2
Teachers Training	12,100	10.3	31,500	16.5	114,800	26.0	94,300	14.0	109,700	19.4	249,900	29.2	338,200	29.6
Liberal Arts	11,800	10.2	13,500	7.1	19,600	4.4	45,000	6.8	42,900	7.6	46,200	5.4	58,100	5.1
Science	7,000	6.0	9,600	5.0	28,700	6.5	62,100	9.2	39,300	7.0	64,200	7.5	83,600	7.3
Finance and Economics	19,400	16.6	22,000	11.5	12,100	2.7	18,100	2.7	6,600	1.2	18,200	2.1	37,100	3.3
Political Science and Law	7,300	6.3	3,800	2.0	8,200	1.9	4,100	0.6	400	0.1	1,300	0.2	6,000	0.5
Physical Education	300	0.2	300	0.2	3,300	0.7	4,000	0.6	5,800	1.0	8,600	1.0	9,400	0.8
Art	2,800	2.4	3,600	1.9	2,500	0.6	4,200	0.6	4,400	0.8	5,700	0.6	6,000	0.5
Total	116,500	100.0	191,100	100.0	441,200	100.0	674,400	100.0	564,700	100.0	856,300	100.0	1,143,700	100.0

TABLE B–5.—DISTRIBUTION OF GRADUATE STUDENTS BY SECTOR

	1965	1978	1980
Colleges and universities	3,528	8,396	17,728
Chinese Academy of Sciences	943	1,381	1,393
Academy of Social Sciences	.....	405	594
Ministries and commissions	75	752	1,577
Provincial level institutions	.....	.....	312
Total	4,546	10,934	21,604

TABLE B–6.—DISTRIBUTION OF GRADUATE STUDENTS BY FIELD OF SPECIALIZATION

	1949	1952	1957	1965	1978	1980
Engineering	94	508	628	1,808	4,011	7,206
Agriculture and forestry	21	90	223	395	331	724
Medicine	83	.....	239	248	1,474	3,651
Education	78	115	724	.....	693	1,704
Liberal arts	119	878	686	306	1,358	2,628
Science	87	57	419	1,740	2,774	4,705
Finance and economics	121	908	112	14	49	451
Political science and law	26	168	5	10	.....	171
Physical education	.....	10	139	18	62	200
Art	.....	29	3	7	182	164
Total	629	2,763	3,178	4,546	10,934	21,604